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CHAPTER 2 NIOSH Personal Protective Technology Program Overview

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Surveillance data published by the U.S. Bureau of Labor Statistics (BLS), considered the best data available, document the burden of injury and illness associated with work in the United States. In 2005, there were 5,702 occupational fatalities in the private sector, an average of 15 per day. Additionally, there were 4.2 million nonfatal injuries and illnesses in the private sector.[1] This human toll is accompanied by significant economic cost. The Liberty Mutual 2005 Workplace Safety Index estimated that employers spent \$50.8 billion in 2003 on wage payments and medical care for workers hurt on the job.[2]

Exposures, fatalities, and injuries among the nation's workers are substantially reduced with the use of personal protective equipment (PPE) and personal protective technology (PPT). It is estimated that 20 million workers use PPE on a regular basis to protect them from job hazards and to prevent more than 700,000 lost workdays.[1] PPE protects workers from death and disabling injuries and illnesses by protecting from exposures to inhalation, dermal, and injury hazards.

The diversity of worker populations coupled with varying workforce acceptance of PPT makes broad implementation of PPT difficult. Generally, the likelihood for proper selection, use, and care of PPT is predicated on the individual worker's or organization's perception of risk for exposure. Where injury history and consequences are not common, PPT may be ignored or improperly used leading to the potential for accidental exposure and consequent injury. Unfortunately, in some cases, the manifestation of injuries may not be acute and thus require several years to develop into some chronic health issue as is the case for many chemicals. Furthering the problems of widespread implementation are issues related to human factors, particular with the burdens created by PPT on the wearer.

The mission of the National Institute for Occupational Safety and Health (NIOSH) PPT Program is to prevent work-related injury, illness, and death by advancing the state of knowledge and application of PPT. The PPT Program aims to be the leading provider of quality, relevant, and timely PPT research, training, and evaluation.

The PPT Program has defined three strategic goals: 1) reduce exposure to inhalation hazards, 2) reduce exposure to dermal hazards, and 3) reduce exposure to injury hazards. The PPT Program, like other cross-cutting programs in NIOSH, impacts all industry sectors and several other NIOSH programmatic cross sectors. The PPT Program is accordingly managed through a matrix approach that involves efforts in several NIOSH divisions. The dynamic nature of the matrix structure directs resources to meet both national priorities (e.g. emerging technologies such as nanotechnologies and Chemical, Biological, Radiological, and Nuclear (CBRN) hazards, stakeholder needs) and Congressional appropriations and mandates.

Overall management of the PPT Program resides with the senior staff of the National Personal Protective Technology Laboratory (NPPTL), a division within NIOSH. PPT Program Goals 1 and 2, focusing on exposures to inhalation and dermal hazards respectively, consist of activities almost solely performed by the staff of NPPTL.

Goal 3, focusing on worker exposures to injury hazards, includes activities performed in several NIOSH divisions. These PPT activities are often only a small part of larger projects managed by other NIOSH programs. For example, PPT activities concerning hearing protection are part of the NIOSH Hearing Loss Research Program, and are managed by others within NIOSH.

Occupational hearing loss is damage to the inner ear from noise or vibrations due to certain types of jobs or entertainment.[3] While hearing loss may be classified as a work related illness,[4, 5] the PPT Program includes hearing loss among occupational injuries described in this evidence package since hearing protectors reduce exposure to noise hazards associated with workplace injuries resulting from excessive noise.

Table 2.1 provides the relationship between PPT Program goals (and the appropriate component parts for Goal 3) and the status of relevant National Academies' reviews.

Table 2.1 - PPT Activity Structure within the NIOSH Program Matrix

PPT Goal	Primary Sector or Cross Sector Management Responsibility	Relevant National Academies (NA) Reviews
Goal 1: Reduce Exposure to Inhalation Hazards	PPT Program	PPT Program
Goal 2: Reduce Exposure to Dermal Hazards	PPT Program	PPT Program
Goal 3: Reduce Exposure to Injury Hazards		
Area: Warning and Locator Devices	PPT Program	PPT Program
Area: Hearing Protection	Hearing Loss Research (HLR) Program	Hearing Loss Report (2006) The HLR program has developed an action plan to address issues raised in the report. [6]
Area: Fall Protection	Traumatic Injury (TI) Program	Traumatic injury review (in progress)
Area: Vibration Gloves	Construction Program	Construction review (in progress)

Goal 3 projects and related activities have been (or are presently being) reviewed as part of their parent programs within the framework of the National Academies Evaluation of NIOSH Research Programs, except for research in support of the objective to develop and evaluate warning devices for fire services. This specific research activity is included in this Evidence Package as Chapter 5. The other Goal 3 projects are contained in Appendix D; they are included for completeness and to indicate the comprehensive nature of the PPT Program, but should not be reviewed.

This overview chapter provides the background and managerial strategy that establishes the history and foundation of the PPT Program.

2.1 The Relationship Between Personal Protective Equipment (PPE) and Personal Protective Technology (PPT) within the NIOSH PPT Program

Occupational Safety and Health Administration (OSHA) defines PPE as “specialized clothing or equipment worn by employees for protection against health and safety hazards.”[7]

The PPT Program defines PPT as the technical methods, processes, techniques, tools, and materials that support the development, evaluation, and use of PPE worn by individuals to reduce the effects of their exposure to hazards.

The NIOSH PPT Program encompasses both PPE and PPT. For example, a respirator is considered PPE while the facepiece, straps, service life indicator, filter, guidance documents,[8] standards, and test procedures are considered PPT. Thus, any of these are appropriate for investigation and analysis as part of the PPT Program’s research, policy and standards development, and respirator certification activities.

2.2 The Role of Mandatory and Consensus Standards in the PPT Program

The development and improvement of mandatory and consensus standards are important components of the PPT Program.

Some standards are federally mandated and administered, such as OSHA 29 Code of Federal Regulations (CFR) 1910.132 - 138 and NIOSH 42 CFR Part 84 standards for certification of respirators.[9, 10] Federally mandated standards are developed by federal agencies following a complex process of rulemaking that strives for open public participation.

Other standards, referred to as consensus standards, are developed by national and international Standards Development Organizations (SDOs) such as the National Fire Protection Association (NFPA). Consensus standards are typically produced by a standards committee structured to achieve balanced representation of users, labor, industry, government, academia, and other subject matter experts. Unlike mandated standards from the federal government, consensus standards organizations typically update standards more frequently and are thus able to include the most current research findings and state-of-the-art practices into their revisions.

OSHA developed the basic PPE standard for general industry (29 CFR 1910.132) in 1971. This standard requires that employers establish and administer an effective PPE program for their employees and that employees be trained in the proper use of PPE. The importance of PPE was highlighted again in 1994 when OSHA established 29 CFR 1910.132-138, the "Personal Protective Equipment" standard.

The only federal government mandated standard for a specific type of PPE is the NIOSH 42 CFR Part 84 for respirators. This regulation defines the minimum design, quality, and performance requirements for respirators, including requirements for particulate respirators. The PPT Program

respirator certification program uses these requirements to certify respirators. These regulations provide OSHA the reference necessary for requiring employers to provide protective respirator types for their employees.[10]

The federal government notice and comment rulemaking process, designed to obtain extensive public review and participation from all interested parties through formal comments and review, is often criticized for the length of time before regulatory changes can become effective. As a result, federal regulations and the consensus standards included in them or adopted by an agency with enforcement authority may not represent current technologies; the consensus standards are often nearing the beginning of their next revision cycle.

To respond to the challenges of federal mandatory standards, the PPT Program has partnered with national and international SDOs to help accomplish the responsibilities defined in (42 CFR Part 84).[10]

The most notable standards development organizations in which PPT Program personnel are involved include:

- International Organization for Standardization (ISO)
- American Society for Testing and Materials International (ASTM)
- American National Standards Institute (ANSI)
- National Fire Protection Association (NFPA)

Consensus standard development committees afford the opportunity for the PPT Program to apply quality science developed by its scientists and researchers to a wide range of PPT. The outcomes from the transfer of PPT outputs to national and international standards are often far-reaching. Not only do the SDO committees offer the possibility of introducing relevant scientific outputs to different types of PPT, but they also promote interaction with stakeholders including influential technology users who can facilitate adoption of PPT outputs. In the case of respirators, consensus standards not only provide a necessary transfer activity, but also represent a source of input for advancing the Program's primary regulation, 42 CFR Part 84.[10]

2.3 The Role of PPE/PPT in the Hierarchy of Controls

Since 1971, NIOSH has recommended that hazards be controlled as close to the source as possible while including PPE as a part of the hierarchy of controls for worker protection. This process for the ordered evaluation of feasible and effective control options is based on a sound, time-tested public health policy strategy. The basis for the hierarchy is that protection that does not rely on individual employee behavior is preferable to that which does. The higher components rely the least on employee behavior. The hierarchy of controls strategy, depicted in Figure 2.1, shows PPT's role as a supporting component of the hierarchy.

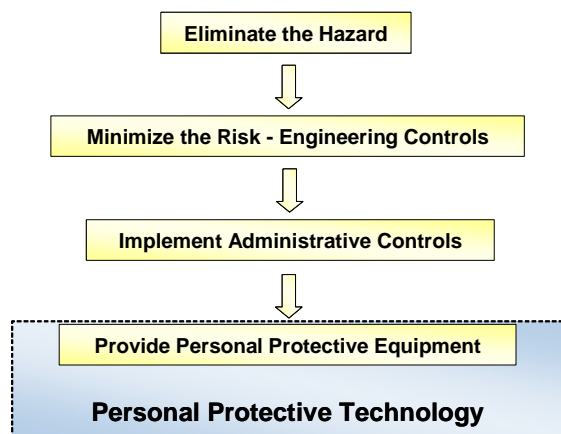


Figure 2.1 - Workplace Hierarchy of Controls

The elements of this hierarchy of control solutions, in order of preference, are:

- *Eliminate the hazard:* Eliminating the hazard is at the high point of the controls because it has the potential to provide protection for the greatest number of people.
- *Minimize the Risk:* Risks minimized by preventing or containing workplace hazards at their source. If the source of the hazard cannot be eliminated, engineering controls can be implemented to minimize risk by physically isolating the worker from the hazard or reducing the hazard with control technologies. Engineering controls do not rely on a worker's correct performance to be successful.
- *Implement Administrative Controls:* Administrative controls remove the hazards from the pathway between the source and the worker. Removing or reducing the ambient level of the hazard can also be accomplished by implementing change in work practices or other administrative controls. Using ergonomics, changing the way work is organized, and training workers are examples of administrative controls.
- *Provide PPE:* PPE controls worker exposure with barriers between the worker and the hazardous work environment. The use of PPE is an effective control strategy for establishing a barrier between the worker and the hazard. PPE is implemented last in the hierarchy of controls because the effectiveness of the PPE depends on human factors, such as managers selecting the appropriate PPE and workers using them correctly. In some situations, using PPE is the only feasible control.

Implementing this “last line of defense” in the hierarchy of controls does not diminish the importance of PPE or of the PPT Program. Indeed, in some situations the use of PPE is the only feasible control for certain hazards. NIOSH criteria documents have consistently recommended the use of PPE, including respiratory protection to prevent inhalation exposures; skin protection to prevent dermal exposures; and eye, face, head, fall, hearing protection and safety shoes to prevent injuries.

NIOSH recommendations have identified four areas of importance for improving the reliability and consistency to exposure prevention for all PPE required in the work setting. These include:

- selection
- training in the proper use
- ensuring proper use
- evaluation of effectiveness
- maintenance

These areas of importance are part of the broad scope of PPT which includes not only PPE but other technologies and disciplines that enable the effectiveness of PPE. The components are consistent with the PPT Program initiative to model its process using the criteria of the Baldrige National Quality Program.

2.4 PPT Program History

NIOSH has placed great emphasis on PPT issues since its inception in 1971. Along with other federal government agencies, notably the United States Bureau of Mines (USBM), NIOSH has continuously supported the research, development, and use of advanced PPT for numerous worker populations. A tabulated account of this history is provided in Appendix B. A shortened version of this history follows.

This section describes the PPT Program history for five time periods:

- Pre - 1977
- 1977 – 1996
- 1997 – 2000
- 2001 – 2005
- 2006 – Present

2.4.1 Early PPT Activities, Including the Creation of NIOSH (Pre-1977)

The history of the research, development, and use of personal protective technologies in the United States can be traced to the late 19th century. The first concerted effort to address the safety and protection of coal miners was the creation of the USBM in 1910. Early efforts by its staff were aimed at determining whether fatalities from coal mine explosions were caused by injury or suffocation.

Throughout its history, the USBM provided a federal government focal point for activities involving respirator research and analysis. These efforts covered both private sector and military applications. The USBM was solely responsible for testing and certifying respirators until NIOSH was established.

When NIOSH was established in 1971, a crucial need to determine the correct role of respiratory protection in workplaces was recognized[11]. While dedicating the majority of its resources to the fundamental concepts of industrial health and safety, NIOSH also devoted a significant part of those resources to three areas of respiratory protection: research, certification, and training.

In 1972, NIOSH published 30 CFR Part 11[12] jointly with the USBM. This information represented the earliest beginnings of the PPT Program. Under a Memorandum of Understanding (MOU) with the USBM, the PPT Program was responsible for administration of the regulation's quality control provisions. In 1973, NIOSH undertook primary responsibility for performance testing of respirators and the USBM retained only the responsibility to test for intrinsic safety on the small number of respirators that had electrical components, while co approving all respirators.

The PPT Program in 1972 also began to include research in several areas of respiratory protection. Research addressed developing new tests and procedures to meet the protection needs of workers beyond those employed in mining and pesticide applications. It also addressed the potential use of military gas masks for workplace applications. Issues that were identified included: the efficacy of facepieces to prevent leakage; the use of filters and cartridges to remove contaminants from ambient air; and the development of atmosphere-supplying respirators for delivering uncontaminated oxygen from either self-contained or airline respirators. Other factors included worker acceptance, training, communications, determination of need, selection of equipment, supervision, and inspection and maintenance. Public input concerning the respirator certification program was requested and received.

NIOSH and OSHA established a Joint Respirator Committee in 1973 to develop standard respirator selection criteria and tables for the approximately 400 hazardous materials regulated by OSHA. This committee developed the respirator selection criteria and tables that appear in the NIOSH criteria documents in the initial NIOSH/OSHA Pocket Guide to Chemical Hazards[13] and initial Respirator Decision Logic (RDL).[11] The respirator selection criteria was used in NIOSH criteria documents for defining the types of respiratory protection needed when workplace exposure concentrations exceeded the NIOSH recommended exposure limit (REL). The Respirator Selection Logic (RSL 2004, updated RDL)[14] provides guidance on how to select the appropriate respirator. It provides a process that respirator program administrators can use to select appropriate respirators to protect workers in specific workplaces.

The responsibility for respirator co-certification with PPT was transferred to the Mining Enforcement and Safety Administration (MESA) within the Department of Interior (DOI) in 1974, under the Coal Mine Health and Safety Act of 1969. The USBM remained active in respiratory protection research related to mine escape and rescue.

2.4.2 PPT Program, Including the Creation of DSR (1977-1996)

In 1977, the NIOSH Division of Safety Research (DSR) was created in Morgantown, West Virginia, becoming the first division-level focus on PPT research within NIOSH. DSR work included the testing and certification of respirators and other PPE.

The first publication officially attributed to DSR was a report on the Tests of Plastic Plano Safety Spectacles published in November 1977.[15] Researchers in the new division also served as consultants to the Division of Technical Services in publishing two guides for respiratory protection, one targeted at employers and one at workers. That same year, MESA was re-designated as the Mine Safety and Health Administration (MSHA) and transferred to the

Department of Labor with the respirator certification mandate under the 1977 Act. While MSHA reviewed applications for respirator certifications and conducted some product evaluations, laboratory testing, quality assurance, and product audits for certain respirators, the PPT Program conducted the principal testing and certification activities specified by 30 CFR Part 11.[12]

The Program's active projects addressed traditional high priority areas, such as falls from elevation (scaffolding and handrail design), machines (safeguarding metal-cutting lathes and power presses), and low-back injuries (assessing countermeasures). A variety of other efforts, such as studies of warning devices, signs, and labels; high-risk industries, such as explosives and pyrotechnics; and the safety functions of occupational health nurses were also conducted.[16-21]

In the early 1980s respirator experts on the Ad Hoc Air-Purifying Committee of the ANSI Z88 Committee, including representatives from major respirator manufacturers, sent comments to NIOSH pointing out technical aspects of the 30 CFR Part 11 certification tests. As a result of these comments and subsequent discussions, NIOSH and MSHA proposed comprehensive revision to the 30 CFR Part 11 certification requirements. The result was a new 42 CFR Part 84, published for public comment on August 27, 1987.

Two public meetings were held on the proposal during 1988[10, 12], resulting in 271 comments. After review, it was determined that at least four major, and more than 100 minor technical and administrative changes would be required. Consequently, the intent to develop and implement a single, comprehensive revision to the regulation was revisited with the development of 42 CFR Part 84 in 1995.[10]

Prior to 1995, all respirator certifications were issued jointly by MSHA and NIOSH. Under the new respirator certification regulations (42 CFR Part 84), NIOSH became the sole approving authority for most respirators. Concurrently with publication of this new rule, MSHA published a final rule to remove existing regulations at 30 CFR Part 11, which were made obsolete by the final rule. NIOSH continues to have exclusive authority for testing and certifying respirators with the exception of certain mine emergency devices, which continue to be jointly certified by NIOSH and MSHA.[10, 12] An MOU between NIOSH and MSHA was published concurrent with the final rule.

Figure 2.2 depicts the PPT Program organizational structure from 1977-1996. DSR managed the distribution of research activities relative to PPT Program Goals during this period. DSR was assigned responsibility for performing PPT research and respirator certifications. Creating DSR was the beginning of NIOSH's efforts to focus its PPT Program on reducing worker exposures to inhalation, dermal, and injury hazards. This focus continues today.

Activities related to reducing exposures to injury hazards were spread across the NIOSH divisions as shown in Figure 2.2. The Education and Information Division (EID) led the development of NIOSH scientific information products such as guidance documents. The Division of Applied Research and Technology (DART) was responsible for NIOSH hearing loss prevention research. The Health Hazard Evaluation (HHE) Program in the Division of Surveillance, Hazard Evaluations and Field Studies (DSHEFS) was responsible for responding to formal requests concerning potential hazards in the workplace and

providing recommendations to address identified hazards. Recommendations concerning PPE and PPT, provided within the context of the hierarchy of controls, were commonly included among those provided. The Office of Extramural Programs (OEP) coordinated external grants. The grant program was operated independent of the intramural activities. NIOSH used the National Institutes of Health (NIH) model for administering its extramural program, allowing NIOSH to partner with other components of the U.S. Public Health Service in supporting occupational safety and health research. This system also ensured that high quality research was funded through a two-step peer-review process.

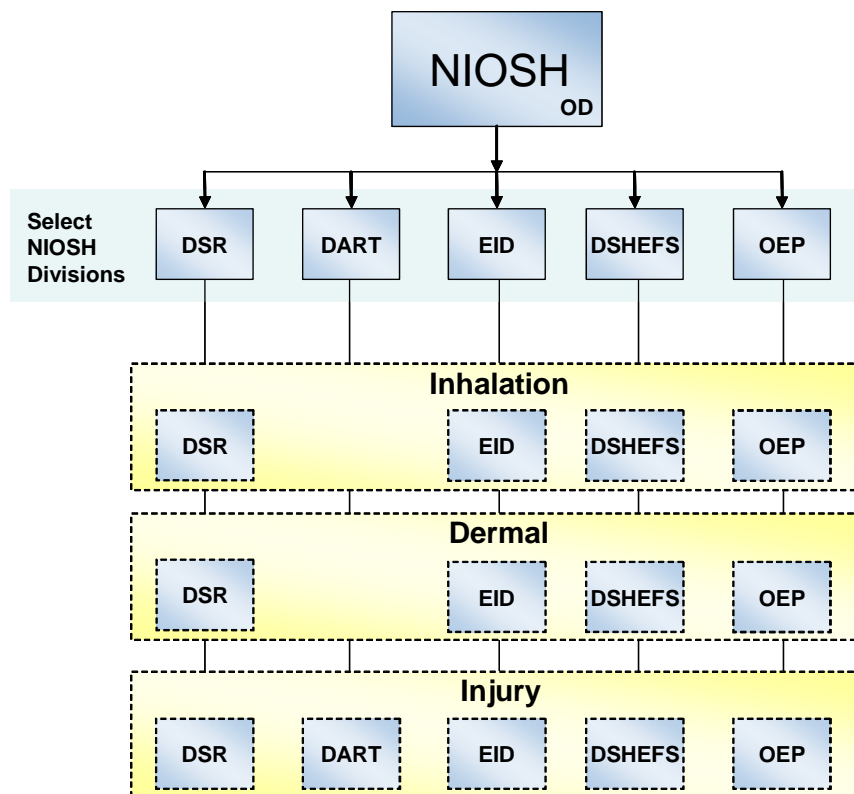


Figure 2.2 - PPT Program Organizational Structure* 1977-1996

* Division names correspond to present organizational structure

2.4.3 PPT Program (1997-2000)

Two significant events occurred during 1996-1997 that had major impacts upon the PPT Program:

First, the USBM was abolished, resulting in the transfer of the Pittsburgh Research Laboratory (PRL) into NIOSH, together with its hearing protection activities. The USBM Spokane Research Laboratory (SRL) was also transferred at this time. Second, NIOSH's respirator certification functions were transferred from DSR to the Division of Respiratory Disease Studies (DRDS). The resulting assignment of PPT Program responsibilities across the NIOSH organization are shown in Figure 2.3. The focus on reducing worker exposures to inhalation, dermal, and injury hazards was retained. DART conducted PPT research to reduce exposure to injury hazards related to hearing loss.

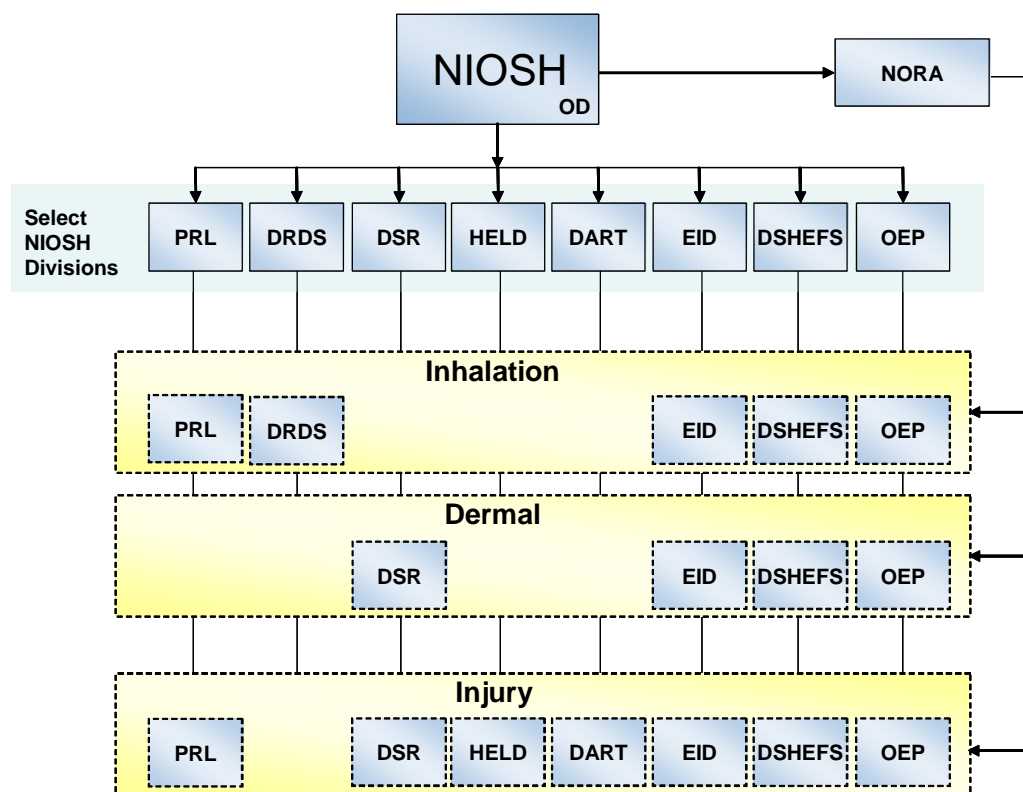


Figure 2.3 - PPT Program Organizational Structure* 1997–2000

* Division names correspond to present organizational structure

Research and certification activities related to inhalation exposures were conducted by DRDS, with the exception of inhalation exposures in the mining environment which PRL conducted. DSR continued to manage research activities related to reducing exposure to dermal hazards, while activities related to reducing exposures to injury hazards remained spread throughout the NIOSH divisions. For example, DART and PRL both conducted research related to hearing protection. DSR conducted fall protection harness research, while the Health Effects Lab Division (HELD) conducted research related to hand vibration syndrome (HVS).

EID continued to provide support for developing guidance documents and products disseminated to the public. The HHE program continued to respond to formal requests concerning potential hazards in the workplace and providing recommendations to address identified hazards.

In combination with the American Industrial Hygiene Association and the American Society of Safety Engineers, the PPT Program held a workshop and conference in March 1998. More than 250 researchers, manufacturers, and users of engineering controls and PPE discussed and set future directions for control technologies to include PPT research. Participants identified six priorities for research: chemical protective clothing, engineering controls, noise, non-ionizing radiation, respirators, and traumatic injuries.[22]

Based on these six areas, recommendations for respiratory protection research in the following areas were proposed:

- Conduct an assessment of respirators used by industry and provide smaller businesses, especially, with recommendations for respirator use and training for the specific industry.
- Standardize terms, recommendations, and protection factors that trigger actions in a respirator program.
- Catalog end-of-service-life indicators for cartridges and filters that do not last indefinitely.
- Research fit testing criteria to learn the optimal duration and frequency of testing, how fit testing results compare to workplace performance, and the cost-benefit of fit testing.

This activity marked the initial PPT effort within NIOSH as part of the first decade of the National Occupational Research Agenda (NORA), the map by which the occupational safety and health community could identify, generate, design, and fund priority research efforts. No previous occupational research agenda had captured such a broad input and consensus. More than 500 individuals and organizations outside of NIOSH contributed to its development.

Another significant input into the PPT Program came from the NIOSH-Department of Defense (DoD)-OSHA-sponsored Chemical and Biological Respiratory Protection Workshop in 1999. This workshop provided recommendations for additional research, guidelines, and standards in the following areas:

- Exposure limits and technology for assessing chemical and/or biological concentrations of response scenarios
- Improved chemical and/or biological detection and monitoring capabilities
- Reliable information with which to define acute vs. chronic doses and their immediate and long-term health effects
- Applicability of military data to civilian scenarios

This workshop provided the framework for the development of NIOSH CBRN standards.

2.4.4 PPT Program, Including the Creation of NPPTL (2001-2005)

In 2001, NIOSH received a Congressional mandate to expand occupational safety and health research.[23] As part of this direction, NIOSH established NPPTL as a new laboratory; to focus on PPT. NPPTL would function as a new division within NIOSH, located on its Pittsburgh Research Laboratory campus in Pittsburgh, Pennsylvania.

The respirator certification and research functions were transferred from DRDS to NPPTL. Other program functions moved to NPPTL included PPE for chemical and biological hazards and the Life Support and Disaster Response Branch from the Pittsburgh Research Laboratory.

A total of 55 full-time equivalent (FTE) positions were identified for transfer into this new PPT Program laboratory. Initially staffed with highly qualified individuals from existing NIOSH divisions, NPPTL was augmented by transfers from other government organizations and through hiring from the private sector.

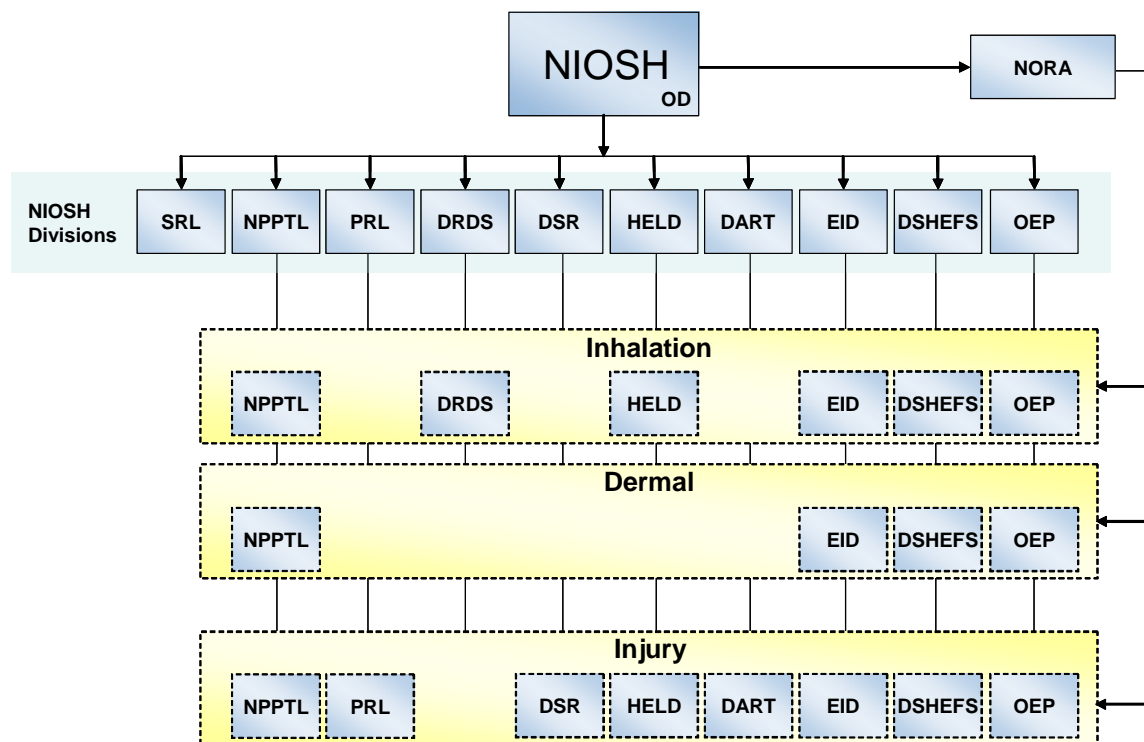


Figure 2.4 - PPT Program Organizational Structure 2001-2005

The resulting distribution of PPT responsibility is shown in Figure 2.4.

A significant amount of the early PPT Program budget was allocated to establishing the needed infrastructure. For the first two years of its existence, NPPTL continued projects transferred from the other divisions within NIOSH, while conducting studies to identify gaps and define new opportunities. All initiatives related to reducing exposures to inhalation hazards were transferred to NPPTL together with protective clothing experts and their associated projects. However, PPT Program efforts related to reducing exposure to injury hazards (fall harnesses, vibration gloves, hearing protection) remained dispersed across other NIOSH divisions.

Because projects on reducing exposure to injury hazards typically include engineering controls, transferring PPT-related activities that were a small part of other larger programs to consolidate PPT initiatives was impractical. The projects remained within their existing divisions, and their management remained unchanged.

The PPT Program leadership within NPPTL launched an infrastructure building campaign to obtain the facilities and personnel needed to address reducing worker exposure to inhalation and dermal hazards. The hiring of staff to fill NPPTL's leadership positions was not completed until 2006. A significant number of these positions are now occupied by experts recruited and hired from the private sector and other federal government agencies other than NIOSH. The number of federal personnel employed by NPPTL throughout its short history is shown in Figure 2.5.

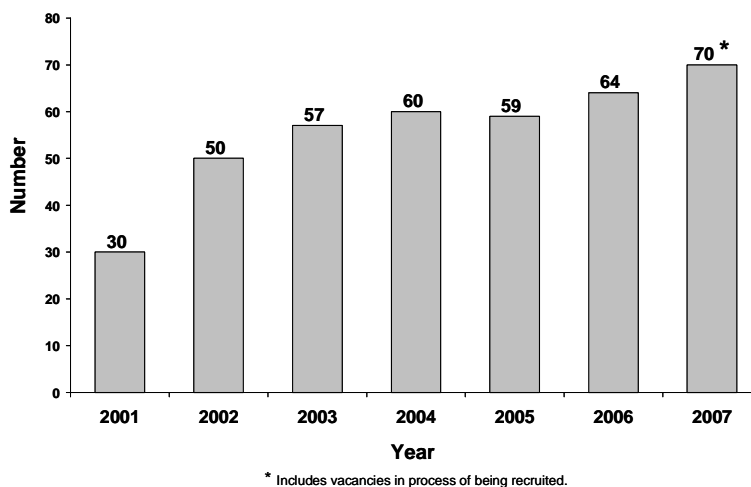


Figure 2.5 - NPPTL Federal Employees (2001 – Present)

In 2001, eight research gaps were identified and described in detail. NPPTL used these research gaps to develop its future activities; specifically, research activities to evaluate end-of-service life indicators for chemical protective clothing and evaluation of health care worker gloves for biological protective clothing were initiated in the protective clothing area.[24]

Workshops and conferences as well as stakeholder and SDO meetings helped shape the research activities dedicated to reducing exposures to dermal hazards. A strategic planning goal to develop, evaluate, and integrate effective residual service-life indicators, other sensors, and predictive models for protective clothing into PPE ensembles was established and published in 2004.[25]

The following discussion of strategic planning initiatives as performed by NPPTL should be viewed as PPT Program initiatives.

The NPPTL business model was developed as part of a comprehensive strategic planning activity initiated shortly after NPPTL was established. The business model highlights the importance of partnerships with key stakeholders for the definition, execution, and ultimate success of its programs. These key stakeholders include technology developers and suppliers who will use PPT Program outputs to produce new products and procedures and user communities whose workers use PPE.

Another result of NPPTL's initial strategic planning activity was the development in 2003 of a Value Creation System (or Logic Model) as shown in Figure 2.6. The system was established as part of the NPPTL initiative to correspond to the criteria of the Baldrige National Quality Program. The Baldrige Program emphasizes defining, measuring, and improving the performance of each part of an organization's value creation system. At its inception in 2003, NPPTL's value creation system included *only* those PPT Program activities conducted within the NPPTL organization.[25]

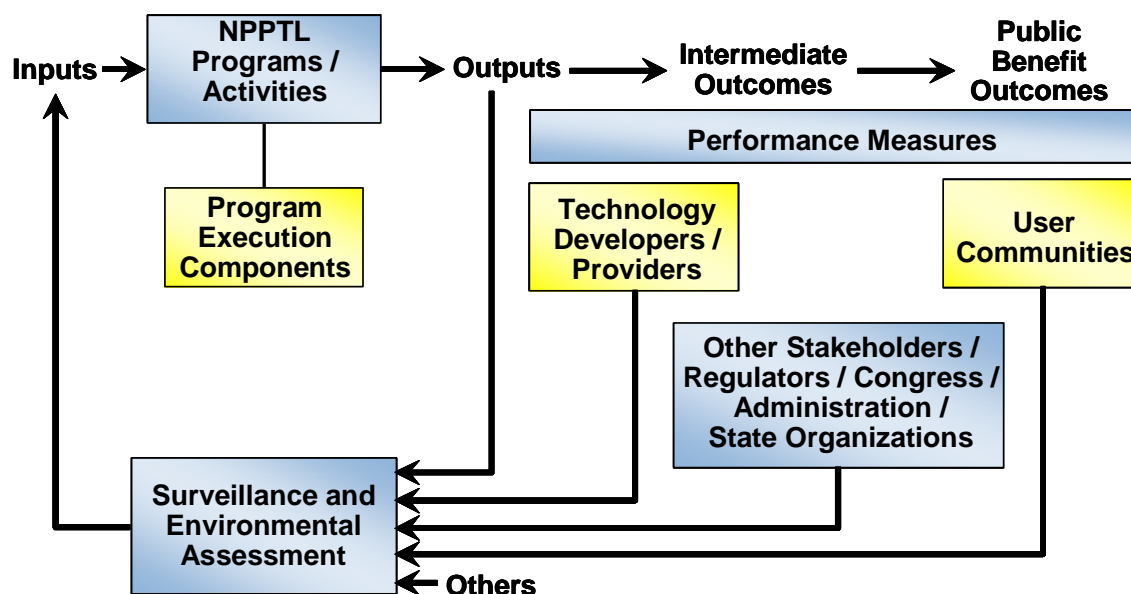


Figure 2.6 - NPPTL Value Creation System [25]

This system guided NPPTL PPT Program initiatives until 2007 when it evolved to its present form as the PPT Program Logic Model. (*The current PPT Program Logic Model is described below in Section 2.7.*) The NPPTL Value Creation System revolves around producing outputs, intermediate outcomes, and public benefit outcomes through the execution of its business model.[25]

Outputs are the direct results of NPPTL activities, and include for example peer-reviewed publications, NIOSH respirator standards, and respirator certifications. Outcomes are the benefits derived through the use of products and services. Intermediate outcomes are the series of benefits that result from the partnerships formed with its technology developers and suppliers, for example national and international consensus standards. Public benefit outcomes involve the reduction of work-related injury and illness, together with reductions in economic, human, and lost opportunity costs within NPPTL's user communities.

NPPTL conducted its first formal environmental assessment in 2005. A key result of this assessment was establishing the National Academies Committee on PPE for the Workforce (COPPE). The assessment revealed the need to incorporate nanotechnology initiatives into the research activities, to continue the focus on developing standards to address CBRN protections, and to emphasize pandemic influenza preparedness in our research, policy and standards development and respirator certification activities. NPPTL also committed to allocating 3% to 8% of the annual budget to evaluation activities to maximize the relevance, quality and impact of its programs.

NPPTL also allocated 3% to 5% of its annual budget to outreach activities, including participating in SDOs and maintaining an active presence at relevant conferences such as those

sponsored by the American Industrial Hygiene Association (AIHA) and Fire Department Instructor's Conference (FDIC).

Approximately one year after NPPTL began to fully implement its strategy, NIOSH established the program portfolio strategy introduced in Chapter 1. The NIOSH program portfolio structure established in 2005 was an opportunity to align the PPT Program Strategy to ensure inhalation, dermal, and injury-related projects were fully coordinated across NIOSH. This strategy established the PPT Program as a cross-sector program within a program portfolio structure categorized by industry sectors, cross-sectors and emphasis areas. The NPPTL Director was selected as the Program Manager for the PPT Program and immediately established a team of PPT experts across all NIOSH divisions to identify all PPT projects and related activities throughout NIOSH.

2.4.5 Present PPT Program Structure (2006 – Present)

The NIOSH cross-sector program alignment defined in 2005 resulted in the PPT Program Management Structure shown in Figure 2.7.

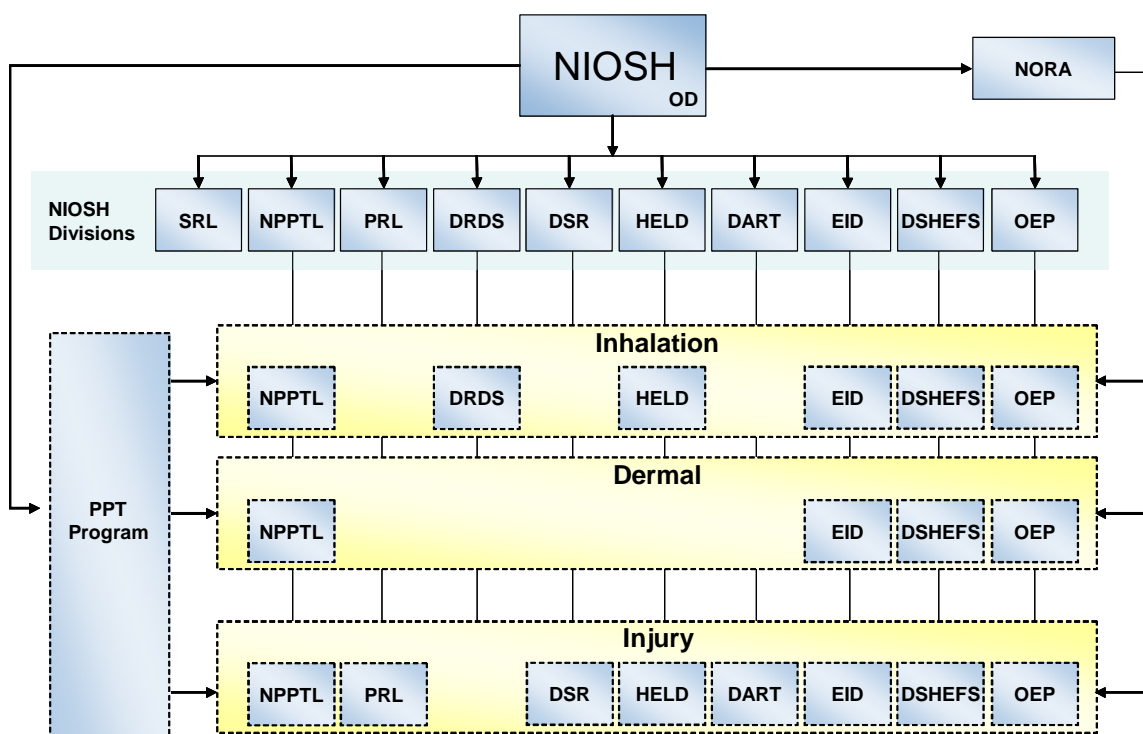


Figure 2.7 - PPT Program within NIOSH Organizational Structure – 2006 - Present

Under this structure, the NPPTL Director is the responsible manager for the PPT Program and the NPPTL Associate Director for Science is its coordinator. The intramural activities related to inhalation and dermal activities/goals primarily are performed within NPPTL. Other NIOSH divisions collaborate with NPPTL on activities where they have expertise to support the efforts of the PPT Program. EID provides support for developing guidance documents and products

disseminated to the public. DSHEFS conducts HHEs in response to formal requests concerning the broad range of potential hazards in the workplace. OEP manages the grant process including peer reviewing submitted grants, monitoring grant progress and reports, and identifying and submitting the request for proposals related to all PPT Goals.

Historically, the intramural and extramural processes have operated fairly independently of one another. In recent years, OEP has realigned the grant program to emphasize high priority issues and relevance within the NIOSH framework.[26]

2.5 PPT Program Strategic Goals

The adoption of the program structure by NIOSH has resulted in program goals to reduce exposures to inhalation hazards, dermal hazards, and injury hazards.

Each strategic goal is divided into objectives, as outlined below. Objectives are categorized by activities conducted to address the high priority areas identified through strategic planning to include national priorities and Congressional mandates. These objectives have timeframes that are longer than the annual targets contained in project and related activities plans, though shorter than those for the far reaching strategic goals themselves. Concerted effort over several years will be required to evidence significant progress towards their accomplishment.

Specific performance measures associated with each goal are being established. *Therefore, the evaluation committee should assess the quality, relevance, and impact of the outputs and intermediate outcomes and associated end outcomes relevant to the PPT Program.*

The tactical approaches for accomplishing the strategic goals fall into four categories (conduct research; develop standards; certify and evaluate equipment; and conduct outreach programs and activities). The tactical approaches are further described here:

- *Conduct research on PPE and PPT:* This approach involves creating and managing a comprehensive research program to address inhalation, dermal, and injury hazard knowledge gaps and improve existing technologies to reduce exposure to the hazards.
- *Develop standards for PPE and PPT:* This approach aims to support the development of PPT standards and test methods to improve the quality, protection, and performance through all PPE lifecycle stages to reduce exposure to inhalation, dermal and injury hazards. The PPT Program actively participates in PPT standards writing activities with ISO, ANSI, NFPA, ASTM and International Safety Equipment Association (ISEA) in the areas of respiratory protection, hearing protection, eye and face protection, fall protection, industrial head protection, and protective clothing. These standards writing activities include not only product performance requirements, but areas such as use and maintenance of personal protective equipment. ANSI accredits all of the standards setting organizations involved with PPT including the NFPA, ASTM, American Society of Safety Engineers (ASSE), AIHA, and ISEA.

- *Certify respirators and evaluate PPE:* This approach aims to provide quality PPT/PPE evaluation services, recommendations and respirator certification services to enable the availability of effective PPE.
- *Conduct outreach programs for optimal use and acceptance of PPE by workers:* This includes the development and use of effective communication tools and outreach techniques to encourage inputs to all PPT Program activities and to facilitate transfer of outputs (products and services) and outcomes (results) to all stakeholders. Outreach may also be in the form of presentations and displays at conferences, website transfer and dissemination of information, and listserv postings to name a few.

Strategic Goal 1: Reduce Exposure to Inhalation Hazards (Chapter 3)

- Objective 1* Ensure the integrity of the national inventory of respirators through the implementation of a just-in-time respirator certification process.
- Objective 2* Develop CBRN respirator standards to reduce exposure to CBRN threats.
- Objective 3* Ensure the availability of Mine Emergency Respirators for escape from mines.
- Objective 4* Improve reliability and level of protection by developing criteria that influence PPE designs to better fit the range of facial dimensions of respirator users in the U.S. workforce.
- Objective 5* Quantify the impacts of various PPE on viral transmission.
- Objective 6* Evaluate the nanofiber-based fabrics and NIOSH-certified respirators for respiratory protection against nanoparticles.
- Objective 7* Develop and make available end-of-service-life indicator (ESLI) technologies that reliably sense or model performance to ensure respirator users receive effective respiratory protection.
- Objective 8* Gather information on the use of respirators in the workplace to identify research, intervention, and outreach needs.

Strategic Goal 2: Reduce Exposure to Dermal Hazards (Chapter 4)

- Objective 1* Improve chemical/barrier protective clothing testing and use practices to reduce worker exposure to chemical dermal hazards.
- Objective 2* Improve emergency responder protective clothing to reduce exposure to thermal, biological, and chemical dermal hazards.

610 *Objective 3* Investigate physiological and ergonomic impact of protective ensembles
 611 on individual wearers in affecting worker exposure to dermal hazards.

612 **Strategic Goal 3: Reduce Exposure to Injury Hazards (Chapter 5)**

613
 614 *Objective 1* Develop and evaluate warning devices for fire services. (Chapter 5)
 615

616 *Objective 2* Develop measurement and rating methods that are representative of the
 617 real-world performance of hearing protection devices. (Appendix D)
 618

619 *Objective 3* Develop hearing protection laboratory and fit testing methods.
 620 (Appendix D)
 621

622 *Objective 4* Evaluate the effectiveness of hearing protection devices to provide
 623 protection from impulsive noise. (Appendix D)
 624

625 *Objective 5* Develop an integrated hearing protection and communication system.
 626 (Appendix D)
 627

628 *Objective 6* Develop hearing protection recommendations for noise-exposed hearing
 629 impaired workers. (Appendix D)
 630

631 *Objective 7* Develop and improve fall arrest harnesses. (Appendix D)
 632

633 *Objective 8* Select and develop vibration isolation devices to reduce hand-arm
 634 vibration syndrome. (Appendix D)

635 **2.6 The PPT Program Logic Model**

636
 637 As previously stated, the mission of the PPT Program is to prevent work-related injury, illness,
 638 and death by advancing the state of knowledge and application of PPT. The associated vision is
 639 for the NIOSH PPT Program to be the leading provider of quality, relevant, and timely PPT
 640 research, training, and evaluation.
 641

642 The PPT Program Logic Model is shown in Figure 2.8. It is a more detailed and expanded
 643 version of the NPPTL Value Creation System developed in 2003.[25]
 644

645 The model identifies two parallel processes, one for the Program's research activity and another
 646 for its certification and policy and standard development. Both processes are guided by the same
 647 inputs, but the Congressional mandate to conduct respirator certification dictates that the
 648 emphasis on the respective inputs be different for each process.
 649

650 The Logic Model also indicates that effective partnerships are crucial to the success of the PPT
 651 Program. Because partnerships are so important across the entire range of components of the
 652 model, they will be discussed in a separate subsection.
 653

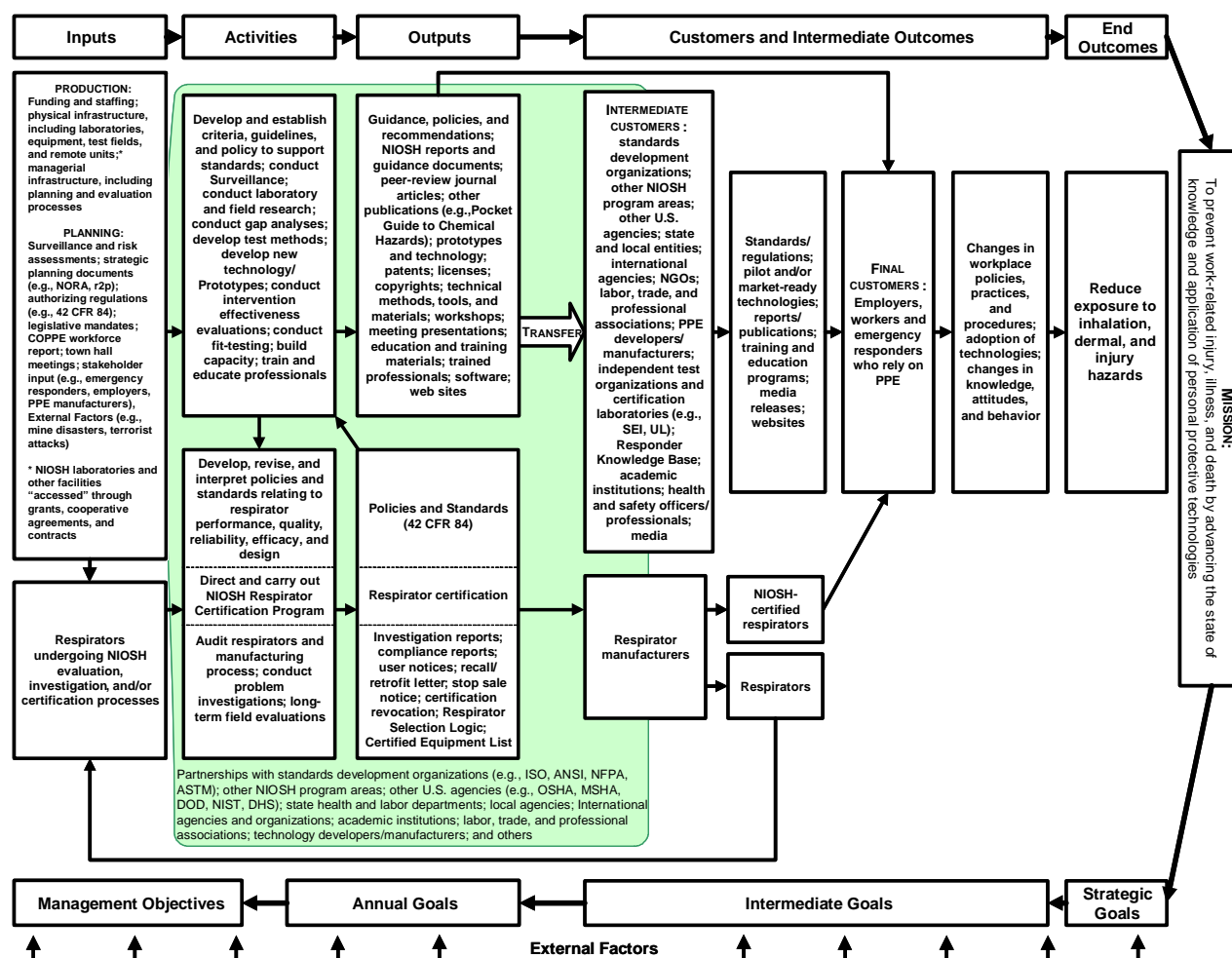


Figure 2.8 - PPT Program Logic Model

Key aspects of the model are summarized below.

2.6.1 Stakeholders and Partnerships

Stakeholders

The PPT Program has a broad range of stakeholders, who are individuals or groups with an interest in its activities. Appendix E contains a listing of selected, significant stakeholders, grouped into seven classifications:

- Academia
- Government
- Industry
- International
- Labor
- Non-governmental Organizations
- Professional and Trade Associations

A key opportunity for PPT Program staff to engage directly with stakeholders is through organizing and conducting public meetings. These activities are important avenues for receiving and disseminating information about activities. Quality information provided through participation or assessment and evaluation enables PPT Program management and staff to make informed decisions about continuing or changing programs and projects. It also provides direction for new initiatives and projects.

Partnerships

Individuals or groups who form partnerships with the PPT Program are a type of stakeholder who has more than an interest in its activities. Partners are also actively involved in the definition and/or performance of the Program's activities, as well as potentially assisting in producing its outputs. Appendix F contains a listing of selected, significant partners.

The PPT Program specifically makes a concerted effort to establish partnerships with appropriate SDOs to align with their activities and objectives. SDOs such as NFPA, ANSI, AIHA, ASTM, and ISO TC-94 have compatible global roles and often their standards compliment each other, as well with those being developed by the PPT Program. Potential exists for leveraging such resources as expertise, research, data, standards, and validated test procedures among these organizations to help PPT Program activities be more timely and cost effective. Partnerships with this type of organization also lead to better scientifically-based standards recommendations.

For example, to assure that laboratory test procedures are reproducible among qualified global laboratories, the PPT Program and ASTM are cooperating to address the need for their standardization. Validated test procedures through round-robin testing are essential to ensure relevant and reproducible test methods.

Other global SDOs that have had substantial impact include those that are participating in the ISO (TC 094) Personal Safety-Protective Clothing and Equipment, SC 15 Respiratory Protective Devices. This initiative is defining universal requirements for respiratory protective equipment performance.

ANSI promotes the use of standards internationally, advocates U.S. policy and technical positions in international and regional standards organizations, and encourages the adoption of international standards as national standards where they meet the needs of the user community. ANSI is the sole U.S. representative in ISO. ISO Technical Committee 94 (TC94) deals with PPT in general. There are several sub-committees under TC94:

- SC 1 - Head Protection
- SC 3 - Foot Protection
- SC 4 - Personal Equipment for Protection against Falls
- SC 6 - Eye and Face Protection
- SC 12 - Hearing Protection
- SC 13 - Protective Clothing
- SC 14 - Fire-Fighters' personal Equipment
- SC 15 - Respiratory Protective Devices

The ISO Technical committee, ISO TC94/SC15, is charged with developing international standards for respirators. The PPT Program actively participates in this activity as U.S. delegates on various working groups. A more detailed discussion about the various SDOs in which the PPT Program participates can be found in Appendix C. NIOSH has representation on SC 6 and is the United States Technical Advisory Group (USTAG) Administrator for SC 15. The ISO Technical Committee, ISO TC94/SC15 is charged with developing International Standards for Respirators. These standards will be used by member countries worldwide. PPT Program employees are members of the USTAG and represent ANSI as US delegates on all three Working Groups and are US experts on all nine Project Groups with SC 15.

Memorandums of Understanding and Interagency Agreements

The PPT Program has a specific type of partnership evidenced by formal, written agreements, either a MOU or Interagency Agreement (IA). These are presented in Appendix G. Descriptions of several of the more significant ones follow.

National Fire Protection Association (NFPA)

The PPT Program formed a partnership with NFPA in 2005 to facilitate the partnering, cooperation, and coordination of activities between them. The primary focus is emergency responder protective clothing and equipment for response to emergency incidents. This partnership includes the development of standards for emergency responder organizations and personnel concerning the safety, deployment, operations, and protection of emergency responders. Under the MOU, PPT Program personnel participate on NFPA protective clothing and equipment standards development committees. The PPT Program also conducts research programs[27] providing technical data and information used in revising current and new protective clothing and equipment certification and selection, care, and maintenance standards.

Safety Equipment Institute (SEI)

The PPT Program established a partnership with SEI in 2004 to facilitate the cooperation and coordination of CBRN certification activities to meet NFPA test requirements. Collaboration occurs on PPE certification program issues concerning performance, testing, and validation of emergency responder PPE with emphasis on open-circuit self-contained breathing apparatus (SCBA). This partnership enables expeditious processing of respirator approval applications by permitting the PPT Program to conduct NIOSH certified CBRN testing in parallel with the testing required under NFPA 1981 (as conducted by SEI). The PPT Program issues a joint NFPA/NIOSH approval upon successful completion of both sets of tests.

American Society for Testing and Materials International (ASTM)

A partnership was formed in 2006 with ASTM International to facilitate interactions regarding performance requirements and test methods, product specifications, practices, guides, classifications, and terminology related to worker and emergency responder protective clothing and equipment. NIOSH personnel serve on the ASTM F23 Committee on Protective Clothing and Equipment Executive Committee and subcommittees related to physical, chemical,

biological, radiological, heat/flame hazards, and human factors. NIOSH conducts research programs providing technical data and information needed by this ASTM F23 Protective Clothing and Equipment Committee.

International Safety Equipment Association (ISEA)

The PPT Program formed a partnership with ISEA to assess emergency responder access to NIOSH-approved CBRN respiratory protective devices. This information is a major contribution to the programs ability to determine the percentage of professional firefighters and emergency responders that have access to CBRN respirators. (NIOSH PART Goal) In addition to the formal partnership the PPT Program works with the ISEA on topics of interest to PPE manufacturers including research, policy and standards development, and respirator certification.

National Institute of Standards and Technology (NIST)

A Federal government interagency partnership was established with NIST. It has produced national CBRN respiratory protection device standards. Discussions are ongoing to expand the relationship into other areas to improve further respiratory protection.

U.S. Office of Personnel Management (OPM)

An Interagency Agreement between the PPT Program and OPM was established in 2005. Its objective is to assess the quality and effectiveness of current PPT Program collaborations and the customer satisfaction with PPT Program activities. The partnership focuses on improving customer satisfaction by collaborating to administer periodic customer satisfaction surveys.

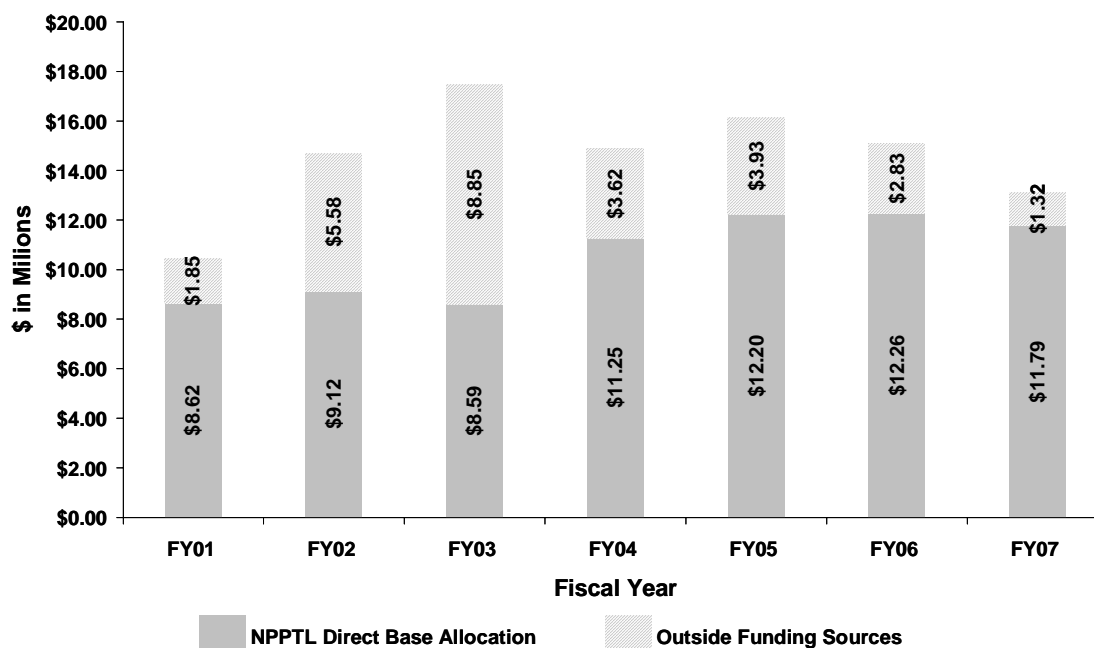
Two surveys have been conducted: one with PPT users; the second with respirator manufacturers because of the unique nature of the respirator certification program. OPM analyzed and presented the results to the PPT Program leadership and staff in February 2006. The PPT Program began to address customer concerns by conducting focus groups with the users and developing action plans of strategies to address the concerns raised in the surveys. Preliminary action plans were presented at public meetings and manufacturer meetings in 2006. OPM recommends conducting the surveys every one to two years. The PPT Program intends to conduct the second survey prior to December 2007 for an update on perceptions of customer satisfaction. The survey results are provided as Appendix H.

This activity has been highlighted in the Organizational Excellence Assessment (OEA) Tool that the CDC is using to measure performance throughout the entire CDC. The action demonstrates the importance of the certification program within NIOSH and CDC as well as NIOSH's commitment to enhance and improve the PPT Program. This importance is echoed in the most recent National Academies report, Measuring Respirator Use in the Workplace, Dec 2006, which states: "The panel is encouraged that the NPPTL leadership continues to place appropriate emphasis on its statutory mission of respirator certification, even as it enriches its program with attention to other objectives. It is proper to maintain this emphasis even as NPPTL moves forward in other areas." [28, 29]

2.6.2 Inputs

Inputs to the PPT Program include both production and planning inputs as well as respirators undergoing NIOSH evaluation, investigation, or certification. Production inputs include funding and staffing, physical infrastructure, and managerial infrastructure such as planning and evaluation processes.

Funding



Total Funding Allocation FY01-FY07 = \$101.79 Million

Figure 2.9 - PPT Program Funding Distribution (in Millions of \$)

PPT Program funding for FY 01 through FY 07 is illustrated at Figure 2.9. Since FY05 annual funding allocations have been stable at approximately \$12.0 million for the base level. Funding from outside sources total \$27.97 million for the period shown. This amount represents approximately 28% of total Program funds of \$101.79 million. The major portion of \$27.97 million was targeted for counterterrorism activities (\$22.8 million) including the development of CBRN respirator standards.

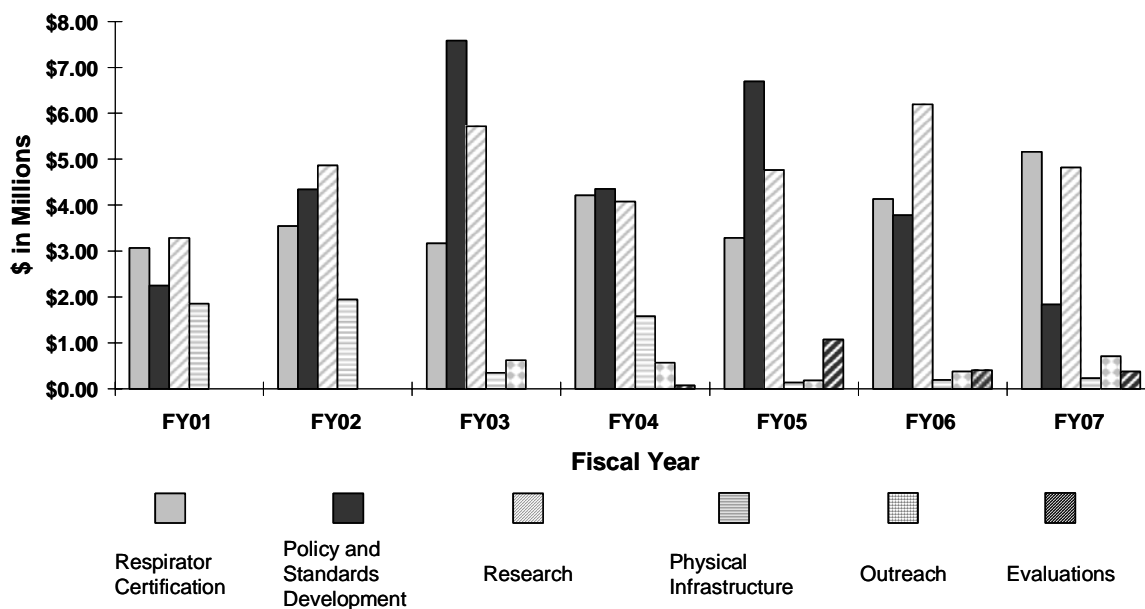


Figure 2.10 - PPT Program Funds Expended (in Millions of \$)

Figure 2.10 illustrates the distribution of funding across the three main Program activities: Research, Policy and Standards Development and Respirator Certification. Funds for each of these activities were approximately 30% of the total funds available, \$101.79 million. Research activities accounted for \$33.72 million, Policy and Standards Development \$30.84 million and Respirator Certification \$26.55 million.

Other observations from Figure 2.10 are the allocations for physical infrastructure at \$6.3 million, with the majority used in FY01 - FY03. These costs were incurred to renovate abandoned USBM buildings for Program laboratories and offices. Two important funding lines are outreach and evaluations. Each accounts for approximately 2% of total funding since FY01. In recent years Program leadership has dedicated a greater amount of resources to these activities and intends to ensure that 3% to 8% is allocated for evaluations and 3% to 5% for outreach to develop and sustain these initiatives.

The OEP research funding for extramural PPT research totals \$8.5 million with the fiscal year breakdown shown in Appendix J. OEP Program funding is listed separate from other funding since these funds are not managed by the PPT Program.

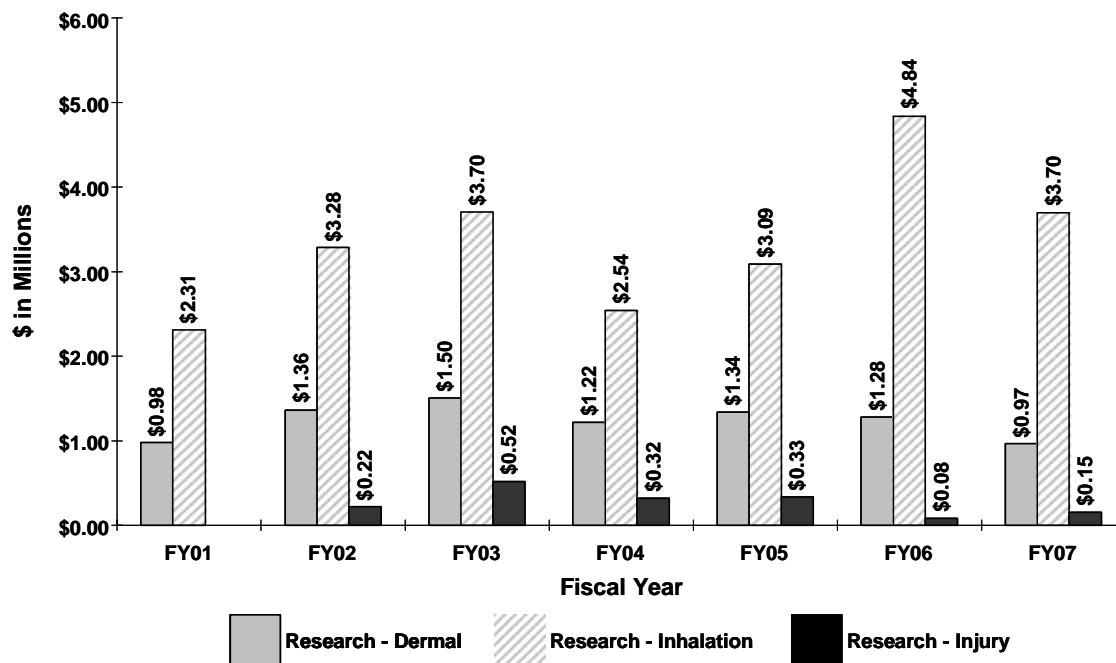


Figure 2.11 - PPT Program Research Funding Distribution (in Millions of \$)

The distribution of research funding by PPT Program strategic goal is provided at Figure 2.11, with inhalation clearly being allocated a significant majority of available funds. Injury research dollars shown are associated with the single Objective to Develop and evaluate warning devices for fire services.

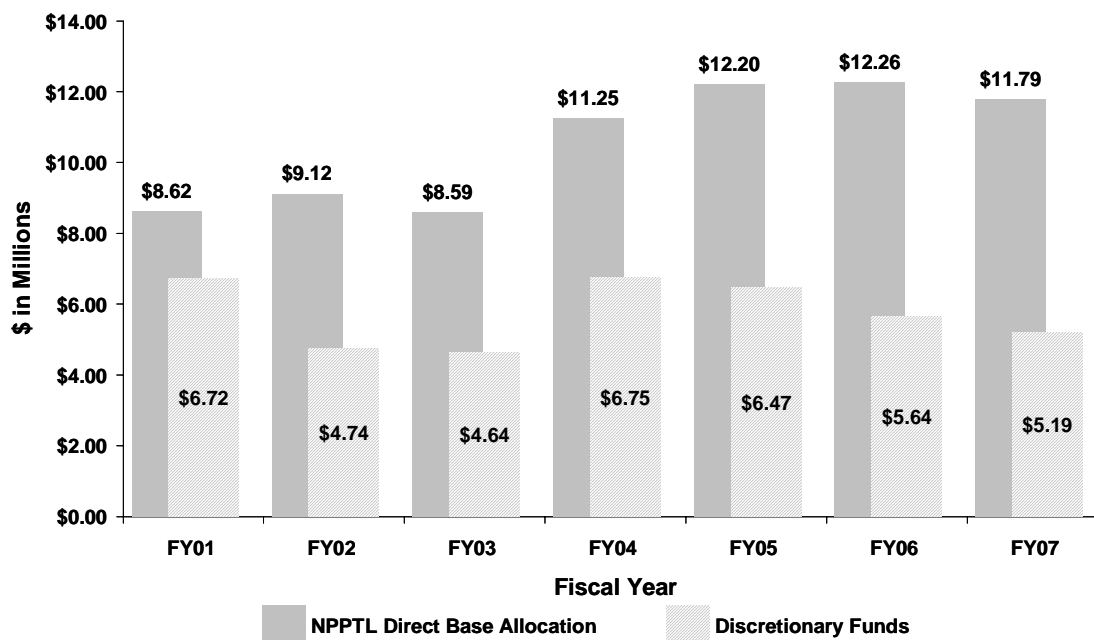


Figure 2.12 - PPT Program Discretionary Funding (in Millions of \$)

The percentage of program funding available after accounting for federal personnel costs are described by NIOSH as “discretionary funds.” This discretionary percentage is an important operating parameter and is used to drive research, evaluation and outreach (research to practice) initiatives for the Program. The percentage of discretionary funds also affects the ability of the Program to react and adjust to external factors. The NIOSH target for percent discretionary funds is 25%. In earlier years the Program operated at a discretionary percentage in the range of 60%.

Current program leadership has identified a target of 30% to 40% of base program funding for discretionary purposes as shown in Figure 2.12. At this range a manageable balance is achieved between programs with a small need for discretionary funds (respirator certification) versus other activities that can benefit from a greater percentage of discretionary funds.

Appendix J provides the same funding information in tabulated form.

Staffing

The distribution of personnel within the PPT Program by expertise is depicted in Figure 2.13.

The figure depicts the prominent specialty (personnel classification) categories within the PPT Program. This distribution demonstrates the heavy reliance on engineers and physical scientists in the PPT Program. Further, a minimal number of epidemiologists and basic research scientists support the PPT Program relative to the other parts of NIOSH. For example, throughout NIOSH

there are 250 epidemiologists on staff while there is only one full time epidemiologist on staff with the PPT Program.

Approximately 10 additional scientists provide support to PPT Program initiatives as needs dictate. Collaborative projects may involve personnel assigned to other NIOSH divisions, but these collaborations vary depending on dynamic PPT Program needs and objectives. Appendix L includes current personnel supporting PPT Programs who are assigned to other divisions and their associated projects.

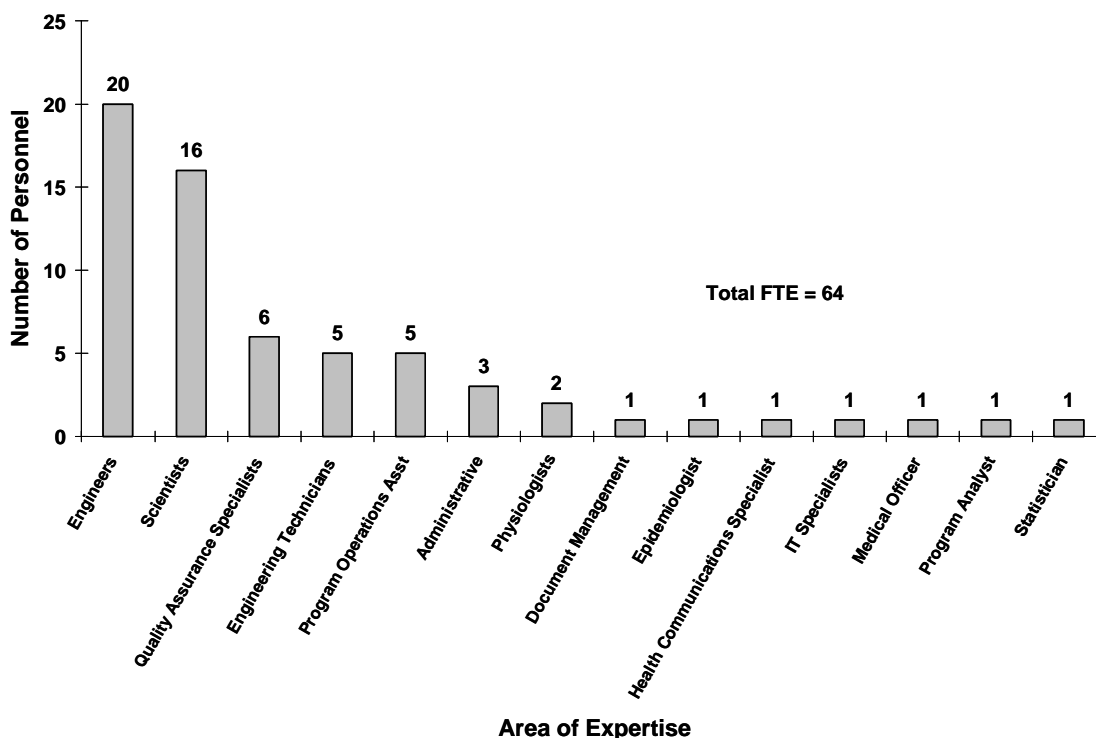


Figure 2.13 - PPT Personnel* by Specialty

* These numbers do not reflect personnel associated with projects undergoing evaluation by other NIOSH Programs.

This personnel distribution highlights the applied nature of the PPT Program and the two parallel paths found within the PPT Program Logic Model: 1) the path to conduct applied research that will lead to products to protect the workers and 2) the other unique respirator certification and policy and standards development activities within the PPT Program.

Physical Infrastructure

PPT Program laboratory and support facilities also are considered production inputs. There are 26 PPT laboratory facilities located in the Pittsburgh, Pennsylvania, three in Morgantown, West Virginia, and one in Cincinnati, Ohio. The descriptions and locations of these facilities and the strategic goals they support are provided in Appendix K. A more detailed breakdown by project is provided in Appendix L. Most of the current NPPTL Pittsburgh facilities are renovated buildings; they are intended to be temporary until a comprehensive facility could be built. As

901 noted above in appendices K and L, four laboratories (three in Pittsburgh, PA and one in
902 Cincinnati, OH) are used to conduct activities to reduce exposure to injury hazards that are
903 undergoing evaluation by other NIOSH programs.

904 ***Managerial Infrastructure***

905 Managerial infrastructure, inputs include strategic planning and operational aspects of the
906 program. Strategic planning is a continuous process that includes a yearly program summit
907 meeting. At the summit meeting program assessments are conducted and decisions made to
908 formulate a program budget for the coming year. Participants include a governance team
909 comprised of key program managers. The same governance team meets periodically throughout
910 the year to review and make decisions about emerging issues impacting the program. Such as
911 “make or buy” decisions. These can involve decisions regarding options of intramural,
912 extramural grant, in-house contract or another government agency. Such analysis may mean that
913 a project would be conducted using internal program resources or using a collaborative approach
914 working with other program sections and partners. Currently the program is engaged in multiple
915 collaborative projects where the PPT Program participates in an effort with program portfolio
916 personnel and/or programs. Operational aspects of the program embrace the principles of the
917 Malcolm Baldrige principles for continuous improvement. These are; leadership, strategic
918 planning, customer market focus measurement and knowledge management, human resources,
919 process development and results. The program uses these criteria to instill a culture of
920 performance excellence.

921 Traditionally, NIOSH research project planning has been conducted at the Division/laboratory
922 level based on annual allocations determined by the NIOSH Office of the Director. The PPT
923 Program has identified “protected” activities which are allocated a particular component of the
924 budget based on establishing a “cost for quality” and on the projected needs. Among protected
925 activities are respirator certification functions necessary to sustain operations and fulfill the 90-
926 day respirator certification application processing requirement, and the initiatives to evaluate the
927 laboratory performance (National Academies evaluations, peer reviews, customer satisfaction
928 surveys). All ongoing projects are reviewed and assessed, and requested resource needs are
929 considered in conjunction with other inputs to the program and with external factors.

930
931 Another protected activity is the PPT Program commitment to r2p through its outreach activities.
932 By protecting the program outreach activities a sustained commitment to address the challenges
933 of technology transfer is maintained.

934 ***Research Planning***

935 Research planning inputs include surveillance and risk assessment knowledge, strategic planning
936 documents, authorizing regulations such as 42 CFR Part 84, Committee on PPE for the
937 Workforce (COPPE) meeting summaries, public meetings, and external factors.

938 At the research project level, planning is primarily a top-down approach with management
939 identifying the program priorities based on the inputs such as funding and staffing, stakeholder
940 needs identified through public meetings, SDO meetings, or through PPE users and employers.

Congressional mandates and emerging technological needs are also considered. Investigators also may propose research projects within the context of the Program drivers. Rather than allocating annual discretionary funding by organizational unit (e.g., Branch), the PPT Program uses a process that aims to ensure that resources focus on the greatest programmatic need, scientific quality, and expected impact of results. Most projects are designed to accomplish specific goals within finite time frames.

Strategic planning for the PPT Program has become a continuous process, culminating in an annual summit where project and program decisions are made. The objectives of the annual strategic planning process are to review the performance of ongoing projects and activities; assess the inputs to the program such as the sector and cross-sector goals within the NIOSH Program Portfolio that are applicable to the PPT Program; align ongoing activities within the PPT Program Portfolio; and prepare “make or buy” decisions.

Assessing all categories of inputs and external factors is the key to achieving maximum relevance and impact. For example, the PPT Program has identified both external and internal factors (through environmental assessments) that may impact activities of the cross-sector. It makes decisions regarding the continuation of current activities and the start of new ones based on these factors. Environmental assessments draw on information from a number of sources including stakeholders, partners, end-user groups, industry, and our own researchers to name a few.

The PPT Program strategy also includes efforts to incorporate the OEP grants into future intramural planning and overall program alignment.

A significant example of research planning input is the National Academies COPPE. The PPT Program funded the committee to provide a forum for discussion of scientific and technical issues about the development, certification, deployment, and use of PPE; standards; and related systems to ensure workplace safety and health. Under the auspices of the COPPE, the National Academies completed evaluations of two NIOSH PPT research projects: Measuring Respirator Use in the Workplace and the Assessment of the NIOSH Head-and-Face Anthropometrics Survey of U.S. Respirator Users.[28, 30]

Reports on these evaluations were delivered to NIOSH in December 2006 and January 2007 respectively. NIOSH is developing statements and action plans to address the issues and recommendations described in the reports. Because of the national priority associated with pandemic influenza preparedness, COPPE recommended the PPT Program focus near-term efforts to examine research directions and certification and testing issues regarding the use of PPE during an influenza pandemic.

To support this effort the PPT Program funded the IOM to assemble an expert committee that conducted a February 2007 scientific workshop designed to identify research directions, certification and standard setting issues, and risk assessment issues specific to PPE for healthcare workers during an influenza pandemic. The committee’s report will guide future activities for the PPT Program in these areas. These efforts and related efforts by the National Academies will feed into the future program development of the PPT Program. NIOSH personnel interested in

initiating PPT Programs and projects are encouraged to review these reports and recommendations when considering submitting a new start to the PPT Program. The report for this activity will be delivered to the PPT Program in September 2007.

Additionally, the PPT Program sponsors numerous conferences and workshops to gain knowledge for input into future program planning. Public meetings introduce concepts and gather feedback on concepts introduced for policy and standard development and planned research activities. These conferences, workshops and public meetings provide input to both the research and respirator certification activities of the PPT Program. Appendix M lists 39 selected conferences, workshops, and public meetings conducted over the past several years that have had input to PPT Program planning. The meetings also may serve as a way to disseminate PPT Program outputs to stakeholders.

Respirators Undergoing Evaluation, Investigation, or Certification

The number of respirators entering into the program as test samples for evaluation to the certification requirements of 42 CFR Part 84 or for performance testing due to a reported or suspected performance problem provide input for resource planning. A pattern change in the number of incoming problem-related evaluations can indicate that the quality component of the manufacturing process may need to be revisited to assure performance at acceptable levels. An increase in the number of candidate respirators for certification evaluation can indicate the introduction of new technology or anticipation of higher demand for the respirator.

Respirators demonstrating performance problems or submitted with unique characteristics or features serve as inputs to the development, revision, and interpretation of policies and standards on respirator performance, quality, reliability, efficacy, and design.

2.6.3 Activities

Respirator Certification, Policy and Standards Development

The activities for the respirator application, evaluation, and audit process are performed with respirators delivered as a result of the certification and audit investigation processes in the PPT Program. The evaluation activities are essentially the same for determining if the performance meets the requirements of 42 CFR Part 84, whether it is an evaluation leading to a decision on issuing a certificate of approval or to resolve a problem. These respirators are undergoing NIOSH evaluation, investigation, and/or certification processes to determine their ability to represent the class of NIOSH certified respirators. Respirators evaluated for the purpose of issuing a certificate of approval require submittal of a formal application from a respirator manufacturer requesting approval. Respirator evaluations for certification also require a fee to be paid by the manufacturer.

The PPT Program develops and assists in the promulgation of new PPE related standards and regulations and updates current standards. The Program identifies where research is needed to support new standards, regulations, and policies relating to NIOSH-certified respirators and other PPE. The program recommends NIOSH policy relating to the approval of respirators, including

approval policies for innovative respirator features. The Program assesses research findings and translates them into effective recommendations for NIOSH policy, regulations, and auditing practices, especially for new PPE technologies or special applications of these technologies. The Program holds public meetings to solicit information concerning users' needs and the feasibility of specific technologies and participates in national and international PPE SDOs and establishes a national/international database of relevant standards.

Research

The activities conducted as part of the research process include developing and establishing criteria, guidelines, and policy to support standards, surveillance activities, laboratory and field research; literature reviews to identify gaps; and development of new test methods.

Activities are distributed by the three goal areas as seen in the project breakdown by goal category in Figure 2.14. This breakdown includes projects that focus solely on activities dedicated to reducing exposures to a particular hazard. The increased number of projects in recent years demonstrates an improvement in management accountability and tracking of PPT Program activities.

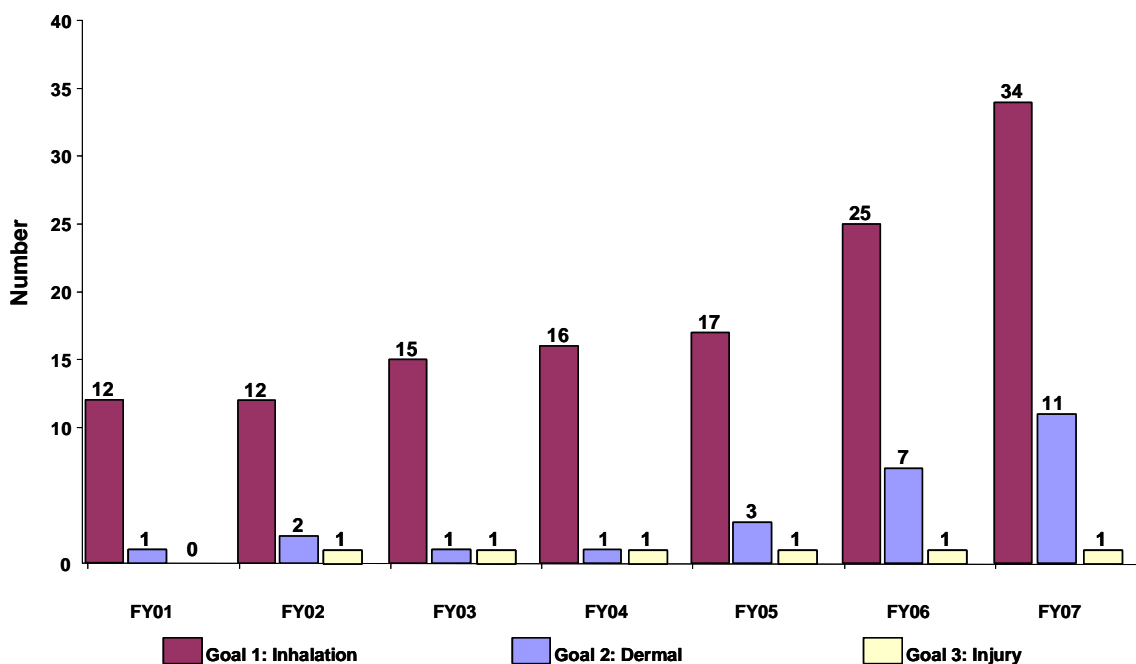


Figure 2.14 - Number of Projects by Goal within Fiscal Years 01-07

Lists of active projects in the PPT Program portfolio are provided in Appendix L.

Grants

Another activity of the PPT Program is the extramural grants awarded by NIOSH. Table 2.2 lists the extramural grants and the timeframe for each. Only grants awarded that have a PPE and PPT component are listed. The PPT Program leadership is developing a strategy to use the outputs from the grants (interim and final reports) as inputs to future program planning.

Table 2.2 - NIOSH Extramural Grants with a PPT/PPE component

Full-Grant-Num	Title	Start	End	PI-Name
5U50OH007544-07H	Pacific Northwest Agricultural Safety and Health Center	9/30/2006	9/29/2011	Keifer, Matthew
5U50OH007542-07F	The Northeast Center for Agricultural Health	9/1/2006	8/31/2011	Murphy, Dennis
5R01OH008669-02	Active Hearing Protectors and Audibility of Critical Communications	8/1/2006	7/31/2011	Brammer, Anthony
5R01OH008119-03	Respirator Effects in Impaired Workers	7/15/2005	7/14/2010	Harber, Philip
5R01OH008165-02	Enclosing hood effectiveness	8/1/2006	7/31/2009	Guffey, Steven
5U54OH008307-04R	Centers for Construction Safety and Health	9/1/2004	6/30/2009	Susi, Pam
5R44OH007664-03	Measuring Human Fatigue with the BLT Prototype	8/1/2006	7/31/2008	Langley, Theodore
5R01OH008806-03	Assessment Methods for Nanoparticles in the Workplace	7/1/2005	6/30/2008	O'Shaughnessy, Patrick
5R03OH008354-02	Multipurpose Protective Clothes for Emergency Responders	4/1/2005	3/31/2008	Sun, Yuyu
1R43OH009026-01	Advanced Personal Gas Detectors for Mining Applications	4/1/2007	10/31/2007	Routkevitch, Dmitri
1R43OH009035-01	Polymer Web Sensing System	4/1/2007	10/31/2007	Bukshpun, Leonid
5R44OH004173-03	SCBA Oximetry for Fire Fighter Physiologic Monitoring	9/30/2000	8/31/2007	Wiesmann, William
5R44OH007673-03A	Bioelectronic Telemetry System For Fire Fighter Safety	9/1/2004	8/31/2007	Masterman, Michael
5R03OH008358-02	Factors Influencing Farmers's Use of Hearing Protectors	8/1/2005	7/31/2007	McCullagh, Marjorie
1R43OH008561-01	Developing a Low-Cost Miniature Personal Noise Dosimeter	9/1/2005	2/28/2006	Cheyne, Harold
1R43OH008192-1A1	Work Injury Risk Reduction Tool for Detection of MSDs	8/1/2005	1/31/2006	Sabelman, Eric
5R01OH004210-04	Using the ASHBMP Manual as a tool to Reduce Farm Hazards	11/1/2001	9/29/2004	Steel, Joel
1 R01 OH004085-01A1	Respiratory Protection Against Bioaerosols in Agriculture (Funded CAN 7457)	6/1/2001	5/31/2004	Reponen, Tina
5 R01 OH003754-02	Permeation of Irritant Mixtures Through Protective Materials (Funded CAN 7457)	6/1/2000	5/31/2003	Que Hee, Shane S.
5 K01 OH000177-04	System for Measuring Workplace Protection Factors (Funded CAN 7457)	9/30/1999	9/29/2002	Groves, William A.
5 R03 OH004164-02	Model Development for the Design of Better Mist Filters (Funded CAN 7457)	8/1/2000	7/31/2002	Raynor, Peter C.
1R43OH007963-01A1	From Nanoparticles to Novel Protective Garments	9/1/2004	5/15/2005	Rajagopalan, Shyamala
S1891-21/22	Field Glove Permeation Instrumental Methods Development (Funded CAN 7457)	10/15/2001	5/8/2002	Que Hee, Shane S.
1 U36 300430A0-01	Risk Assessment for Airborne Bioterrorism Agents (Funded CAN 002J)	2/21/2003	2/20/2004	Nicas, Mark

2.6.4 Output and Transfer Highlights

An output is a direct product of a PPT research project, respirator certification, or policy and standards development activity that is logically related to the achievement of intended outcomes. Created for researchers, practitioners, intermediaries, and end-users, outputs can be in the form of peer-reviewed journal articles, guidance documents, software, PPT test methods, PPT standards, respirator certifications, to name several.

Research to Practice (r2p) is a NIOSH initiative focused on the transfer and translation of research findings, technologies, and information into highly effective prevention practices and products that are adopted in the workplace. The goal of r2p is to reduce illness and injury by increasing workplace use of effective NIOSH and NIOSH-funded research findings. To achieve this, the PPT Program continues to work with our partners to focus research on ways to develop effective products, translate research findings into practice, target dissemination efforts, and evaluate and demonstrate the effectiveness of these efforts in improving worker health and safety.

The PPT Program through the NPPTL addresses the many complex challenges of transferring r2p (outreach). To do this the PPT Program annually allocates 3% to 5% of the base budget for r2p initiatives. The allocation is used to create opportunities for PPT Program scientists to interact with leaders in the occupational safety and health profession. Typical r2p activities included participation in SDOs, membership and active involvement in the Interagency Board for Equipment Standardization and Interoperability (IAB) and other outreach initiatives. These activities enable the PPT Program to develop and sustain r2p.

Standards Involvement

The IAB is a unique opportunity for PPT Program researchers to meet with leaders in the responder community to discuss and learn about issues of importance to the community. Involvement with the IAB is also a major influence in the Program's ability to interact with other government agencies (e.g. DoD, OSHA, U.S. Department of Veterans Affairs (VA), National Institute of Justice (NIJ) and Department of Homeland Security (DHS)).

While SDO participation is a primary target for many of the research outputs of the PPT Program, participation in SDOs also enables PPT Program researchers to meet and interact with technology users and providers. SDO committee members often are leaders in their profession and/or work for industry (sector) leaders who are likely to become early adopters of program research. PPT Program involvement in SDOs includes NFPA, ASTM, ANSI, and ISO activities.

The outreach activities for the Program vary from year to year. These targeted activities also include participation at conferences, workshops, professional meetings and trade shows where Program stakeholders are active. Participation at these events includes dissemination of Program literature and often involves demonstrations of research outputs.

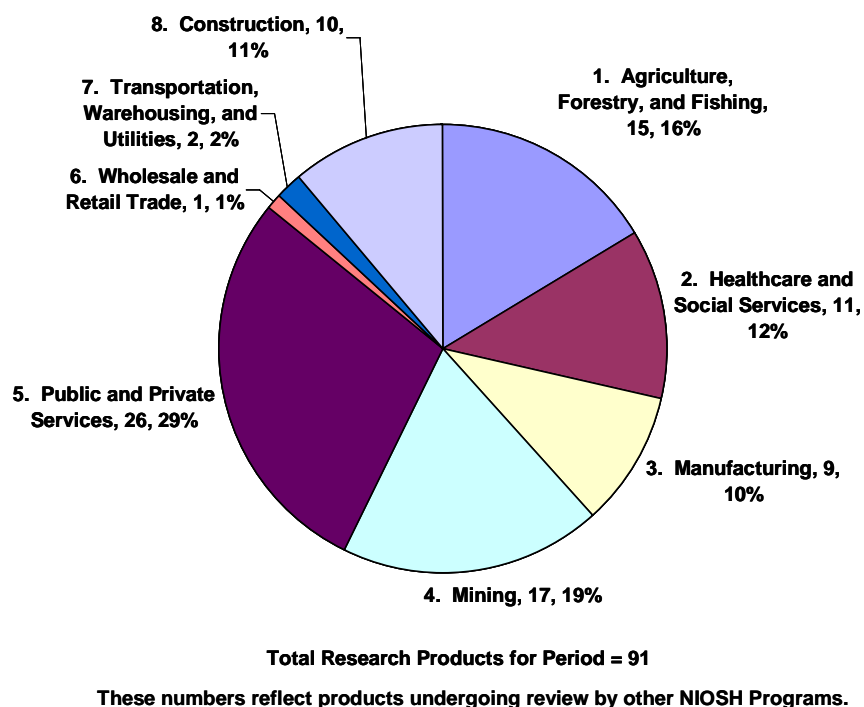
1101 *Conferences and Presentations*

1102 NIOSH has participated in the conferences identified in Appendix M and N over the past several
 1103 years to disseminate NIOSH PPT information and update PPE users and stakeholders on
 1104 research, certification, and standards development activities. Twenty four selected conferences,
 1105 workshops, and meetings are identified in Appendix N.

1106 *NIOSH Scientific Information Products*

1107 The NIOSH publications applicable to the PPT Program reflect initiatives across all industry
 1108 sectors and goal categories: Agriculture, Forestry, and Fishing; Construction; Health Care and
 1109 Social Assistance; Manufacturing; Mining; Services; Transportation, Warehousing and Utilities;
 1110 Wholesale and Retail Trade. Most outputs are distributed to fire services and mining, while
 1111 Transportation, Warehousing, and Utilities; and Wholesale and Retail Trade PPT focus is
 1112 minimal. The distribution of PPT-related products is shown in Figure 2.15.

1113 These products include NIOSH scientific information materials such as guidance documents,
 1114 video training aids, and software. (Other products, such as manuscripts in peer-reviewed
 1115 publications and presentations at scientific meetings are not included.) The products included in
 1116 the figure are NIOSH scientific information products available for distribution to the public on
 1117 the NIOSH website or through the NIOSH publication distribution office.



1118

1119 **Figure 2.15 - PPT Program Scientific Information Products by Workplace Sector 2001-2007**

Peer Reviewed Manuscripts, Conference /Poster Presentations

Figure 2.16 provides the distribution of inhalation and dermal related peer reviewed publications and conference/posters since 2001. The inhalation related products exceed dermal as expected, given the funding allocated to each research activity. Injury products included in Appendix D are not included.

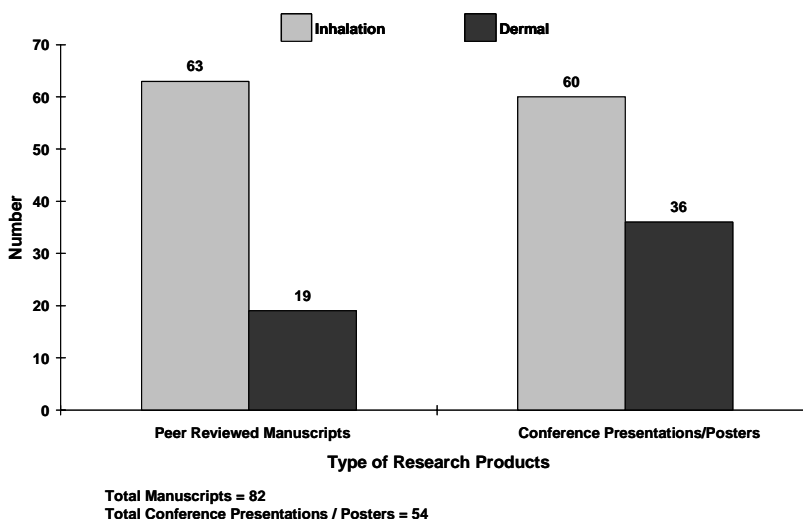


Figure 2.16 - PPT Program Peer Reviewed Manuscripts and Conference Presentations/Posters 2001-Present

These numbers do not reflect publications from activities by other NIOSH Programs

Respirator Certification

The certification of respirators by the PPT Program is its output that has the most direct and immediate impact. The outputs for the respirator certification process include correspondence between the PPT Program and the manufacturers of the respirators delivered for the certification and audit investigation processes in the PPT Program. The correspondence is used to convey the PPT Program's determination of compliance or non-compliance to the applicable 42 CFR Part 84 requirements. A letter is issued granting authorization to label the respirator for sale as a NIOSH-certified respirator from the certification process, or confirmation of continued conformance of audited samples if the performance meets or exceeds the minimum levels of performance in 42 CFR Part 84. If the respirator fails to perform at the minimum levels of 42 CFR Part 84, the PPT Program issues letters to manufacturers about the non-compliance, explaining the means of corrective action.

Having successfully undergone the NIOSH evaluation, investigation, and/or certification processes, the manufacturer is authorized to produce and sell those respirators as NIOSH-certified for use in reducing exposures to inhalation hazards. Properly labeled and distributed respirators can be used by workers for reducing the exposures to inhalation hazards.

The number of respirator certifications issued since the inception of NIOSH totals more than 8,000. The distribution by respirator type is depicted in chapter 3 table 3.1.1. Viewing the respirator certification data in this way offers insight into the level of manufacturers' requests for NIOSH certification, which often are tied to the impact of external influences.

For program evaluation purposes the data from 2001 forward is most relevant.

Investigation Reports

The results from the Certified Product Investigation Process (CPIP) are another significant output for the PPT Program. The objective of the CPIP is to assure workers' safety and health risks are minimized by investigating, analyzing, and resolving concerns with certified respiratory protective products. Since FY01, over 250 investigations have been opened and 248 closed.

User Notices

User notices are outputs of the CPIP activities and are issued to inform potential users of corrective actions that need to be taken to resolve performance problems with NIOSH-certified respirators. User notices issued to implement corrective actions on identified units may be issued by NIOSH, the affected respirator's manufacturer, the component manufacturer if the problem is from a component from a manufacturer other than the respirator manufacturer, or a combination of the three. Distribution of the PPT Program user notices is through email, Internet postings on the PPT website, and, formerly, by mass mailings.

Response to Assistance and Information Requests

More than 100 requests for other types of assistance or information from the PPT Program are typically received and responded to each year. Information requests may be categorized as routine requests for information or emergency response requests.

Routine Information Requests: Information requests that are routinely received in the PPT program are often requests for technical presentations and training sessions by a subject matter expert (SME) to provide a presentation as part of a training course or seminar sessions for a user group. For example, several PPT SMEs were requested to provide presentations on respiratory protection topics at the Filtration 2006 Conference in Philadelphia, Pennsylvania. Labor unions, such as the International Chemical Workers Union (ICWU) or the Operating Engineers, often have "Train the Trainer" courses to keep the knowledge current for their safety trainers fulfilling an OSHA 40-hour training requirement. These training sessions can be formal presentations, in classroom settings, or informal question-and-answer sessions. Appendix Q provides representative examples of the types of information and technical assistance requests that the PPT Program responds to regularly.

Program responses to such requests vary in levels of expertise and resource expenditures by the type and complexity of the request. Requests for expert or peer review of publications and other products are examples of a specific area of requests received routinely by the Program's scientists and researchers which are not included in this listing.

Emergency Response Requests: When a disaster occurs first responders and healthcare workers, sometimes referred to as first receivers, are in the forefront of the response activity. Events associated with emergency response usually require an immediate level of response that can only be effectively realized through prior planning, preparation and training. Appropriate emergency responder and receiver protection can best be assured if support systems required for both emergency responders and receivers are readily available. PPT program preplanning or rapid response to an emergency is required to provide timely recommendations of PPE needs.

The PPT Program provides support for disaster response activities which fall into three far reaching areas of involvement. These are:

- Development of disaster support (PPT),
- Participation in response activities as required and/or requested, and
- Post disaster analysis and research that can add to or improve disaster support PPT.

The PPT Program responded to the September 11, 2001 terrorist attacks on the World Trade Center and the Pentagon, the anthrax event of 2001, the 2003 Severe Acute Respiratory Syndrome (SARS) outbreak and the 2005 hurricanes (Katrina and Rita).

As an example, the PPT Program responded swiftly to address workers' immediate protection needs arising from the terrorism attacks on September 11, 2001. Within hours of the attacks, PPT subject matter experts were engaged in developing respiratory protection recommendations for responders. At the request of the New York City Department of Health, PPT Program experts were deployed to the site. Other program experts provided support services from their normal duty stations. Support provided included:

- Assessment of individual jobs and work locations to identify potential hazards, including risk of eye injuries from blowing debris and potential exposures to silica dust, asbestos, and other hazardous materials.
- Identification of supplies and maintenance of updated inventories of PPE (respirators, eye protection, disposable protective clothing, gloves, hearing protection).
- Help selecting appropriate personal protective equipment.
- Development of effective procedures for cleaning and sanitizing respirators on-site to allow for reuse.
- Development and dissemination of written guidelines to help supervisors integrate worker safety and health into site operations.

While the response for the September 11, 2001 attacks was swift and expansive the PPT Program had been engaged in counterterrorism activities prior to the attacks. In 1999 activities were initiated to develop standards for respirators that could be used by the nation's responders in a terrorist attack. Similar program response activities were associated with SARS and hurricanes Katrina and Rita.

1235 **2.6.5 Intermediate and End Outcomes**

1236 Outcomes can be viewed from two different perspectives – intermediate and end outcomes.

1237 End outcomes are reductions in the exposures to inhalation, dermal, and injury hazards. Injuries
1238 and illnesses have complex causes, and any effect of program activities on rates will necessarily
1239 take years to be seen. Therefore, outcomes are often measured on an intermediate timeframe.

1240 Intermediate outcomes are necessary steps that lead to end outcomes – for example, reductions in
1241 the risk of a particular type of injury or illness through improved standards. For occupational
1242 safety and health research programs, achieving intermediate risk reductions is as important as
1243 achieving the ultimate outcome of decreasing injury and illness incidence rates.

1244 Intermediate outcomes include the production of standards or regulations based in whole or in
1245 part on PPT research and respirator certification activities and associated outputs.

1246
1247 Examples of key intermediate outcomes include:

1248 NIOSH-developed CBRN respirator standards were among the first adopted by the DHS. DHS
1249 now uses these standards to award grants for the purchase of PPE for the first responder
1250 community.

1251 Use of NIOSH-certified CBRN respirators, as part of a personal protective ensemble, has been
1252 incorporated by the NFPA into its NFPA 1500, 1991, and 1994 standards.[31-33]

1253 The British Standards Institution (BSI) has included NIOSH CBRN respirator standards
1254 performance requirements and test methods into the British standards for SCBA, air-purifying
1255 respirator (APR), powered air-purifying respirator (PAPR), and escape hoods.

1256 Use of CBRN respirators by emergency responders has been endorsed by the InterAgency Board
1257 for Equipment Interoperability and Standardization.

1258 A 2-hour Internet search identified 70 website links maintained by private and public sector
1259 entities that reference PPT Program products and/or services having a direct connection to the
1260 PPT Program outputs and outcomes. This search focused on CBRN respirator standards which
1261 are exclusive outputs of the PPT Program. Appendix R contains a selected listing of Internet
1262 website links maintained by private sector and public sector entities that reference products
1263 and/or services having a direct connection to the PPT Program.

1264 A 2-hour Internet search confirmed that more than 23,000 NIOSH-certified respirators have been
1265 purchased. The organization, date of purchase, manufacturer, and number purchased were
1266 identified. Appendix S provides a list of responder organizations the PPT Program has identified
1267 as purchasers of respiratory protection equipment made available as a result of the PPT
1268 Program's certifications.

Another Internet search revealed evidence of 68 organizations that have implemented a respiratory protection program requiring the use of NIOSH-certified respirators. These organizations include chemical companies and laboratories, educational consultants, universities, manufacturing and labor organizations, healthcare organizations, and construction organizations. Appendix T provides the details for these organizations. Although the listing is not intended to be comprehensive of all products or services available in the marketplace, it does indicate the diversity of customers across the U.S. economy who support or participate in the use of outputs and outcomes derived from the PPT Program.

2.6.6 External Factors

External Factors are circumstances and conditions outside the program that nonetheless have impact upon it. External factors can be a single event, such as the terrorist attacks of 9/11, or a composite of events and circumstances reflected in perceptions, attitudes, needs, etc. relating to the reliability and consistency of the protection provided by the PPE and PPT controls.

Abolition of the USBM

As noted, in 1997 the two research laboratories of the former USBM (Pittsburgh and Spokane) were merged into NIOSH when the USBM was abolished. This external event led to a number of successful efforts to integrate research efforts among these two new laboratories and the other NIOSH Divisions.

During the late 1990s, a special fund was set aside for collaborative projects that focused on applying mining-related research to agriculture or construction industry sectors. The PPT Program engaged in several interdivisional collaborations in response to this opportunity. Drawing from that experience, in 2001 an interdivisional NIOSH team proposed a suite of research projects. This research program successfully competed for NORA funding and was conducted collaboratively from FY01-FY06.

ICG Sago Mine Explosion

A recent mine explosion at the International Coal Group, Inc (ICG) Sago Mine, near Buckhannon, West Virginia, highlighted the need for longer duration self-rescuer technology. Miners perished due to carbon monoxide poisoning after barricading for a duration requiring far more oxygen than the capacity of their self-rescue devices. Additional oxygen supplies may have allowed them to remain in the barricade until mine rescue teams reached them, or perhaps even to have escaped after waiting for dust and smoke to clear.[34]

A PPT Program analysis led to a new research project via a contract designed to help develop and evaluate a person wearable dockable and hybrid SCSR that will meet the requirements of 42 CFR Part 84, federal mining regulations, as well as any that will result from the recently passed Miner Act.

Multidrug-Resistant Tuberculosis

The recurrence of multidrug-resistant tuberculosis (mTb) among U.S. healthcare workers in the 1990s prompted the successful PPT Program efforts to change the long-standing particulate filter performance requirements established in the respirator certification regulations by the USBM in 1934. New, low cost mask respirators that have replaced high-efficiency particulate air (HEPA) respirators used by hospitals in the control and prevention of mTb were an important outcome of the new respirator classes. Widespread acceptance of the new N95 respirators came quickly as they were found to be more comfortable and cheaper than the HEPA respirators. The first 13 respirators cost less than \$1 to \$3, much less than the HEPA respirators but still more than surgical masks.

Advances in Nanotechnology

Significant research is being conducted in the United States and elsewhere on the potential application of nanotechnology. The PPT Program is investigating nanoparticles as potential workplace hazards, as well as their application as a new technology for improving the performance characteristics of PPE/PPT. It has developed two proposals that received NIOSH Nanotechnology Research Center (NTRC) funding to address the question concerning respiratory protection and protective clothing against nanoparticles.

Influenza Pandemic

Global health and safety experts agree that likelihood of pandemic influenza is high in the coming years. A vaccine for the H5N1 virus does not exist, heightening the urgency for other initiatives to mitigate the influenza's effects. Effective use and availability of PPE is a key aspect of the nation's preparedness for a pandemic. The PPT Program has received \$1 million in funding for research programs to address issues concerning pandemic influenza preparedness.

Emergency Response, Including Terrorism

The PPT Program actively participates in NIOSH-wide responses to emergencies and catastrophes as designated by CDC and requested by NIOSH.

The PPT Program expertise has been, and continues to be, accessed and directly involved in the emergency response activities for numerous intentional, natural, and industrial events. All require real-time response to emergency responder needs for PPE recommendations, availability of appropriate products and guidance documents to abate the hazards, and may involve the rescue and immediate care of victims. In addition to the many people affected by these disasters, emergency responders and healthcare workers are potentially exposed to the resulting hazards.

Examples of intentional disasters where PPT scientists directly participated in the response activities include: the World Trade Center and Pentagon attacks (2,973 dead) and the anthrax letter attacks (5 dead, 17 others infected, dozens of buildings contaminated, \$1 billion cost). Hazards involved with intentional disasters can be varied and severe since the intention is to kill, injure or cause destruction.

Natural disasters and their aftermath also produce extensive hazards. These disasters include volcano eruptions (Mount St. Helens; 54 dead) and hurricanes (2005 hurricane season; 2,280 dead, \$128 billion damage). SARS is an example of an emerging infectious disease concern where PPT expertise was called upon to develop initial PPE recommendations for responders and receivers of patients. Direct program involvement continued as recommendations were refined and clarified as the hazards were better defined. The 1918 pandemic resulted in 20 million deaths world-wide. A future anticipated pandemic is expected to result in 89,000-207,000 deaths, 314,000-734 hospitalizations, 18-42 million outpatient visits, and 20-47 million additional illnesses in the United States alone. The PPT Program is engaged in respirator certification and research issues to prepare for a pandemic.

Industrial disasters are also a major concern. Examples include the recent mine disasters, e.g., Sago mine (13 dead, 1 survived). Industrial disasters typically cause widespread destruction or distress and usually occur suddenly or over a short period of time. The mine disasters were the impetus for the passing of the Mine Act of 2006. The disasters also resulted in expedited efforts to update the mine escape respirator standards, the long term field evaluation program, and future mine escape respirator prototype systems.

2.7 What's Next?

In the PPT Program, different avenues for examining selection, use, and care of PPT will be investigated as it applies to different industry sectors. As each sector represents a different "trade" with its unique forums, tradeshow, publications, and other means for disseminating information, the PPT Program will explore the most efficient means for increasing awareness and interacting with the end user organizations and stakeholders within these respective industries. The PPT program has demonstrated effectiveness with interacting with emergency responder organizations. This same approach will be applied to other sectors.

Each of these individual discussions ends with a What's Next subsection that tries to offer some insight as to where programmatic emphasis could be directed in the future. PPT Program leadership has defined several issues that need to be addressed in the future that impact the overall management of the program, not just individual efforts. These are discussed below.

Coordination of PPT Activities Among NIOSH Sector and Cross Sector Programs

NIOSH leadership continues to implement its matrix style of management across its various divisions and offices, through programmatic definition and external evaluation of its numerous sector and cross sector programs. A key aspect of this effort is the definition of clear strategic goals and objectives around which research and related work can be organized and directed. The objective is to effectively organize its work while satisfying the Office of Management and Budget (OMB) direction that "strategic goals be organized by outcomes such as injuries and illnesses instead of more general topic areas such as reducing all occupational mortality" in the respective sectors.

The updated NIOSH program portfolio goals contains the current version of the strategic goals for each NIOSH sector. A reading of these goals makes it clear that the focus of many of them

1403 within all sectors has indeed been placed on reducing injuries, illnesses, and harmful exposures.
 1404 It is equally clear that the reliance on PPE/PPT will be an integral part of any strategy to
 1405 successfully accomplish this.

1406 For example, the NIOSH Services Sector has defined a Public Safety Sub-Sector Intermediate
 1407 Goal as:

1408 Develop new personal protective equipment that provides sufficient protection from
 1409 physical, chemical and biological hazards for public safety workers while minimizing any
 1410 physiological burden.

- 1411 • Evaluate lighter-weight protective garments/technologies to protect fire fighters
- 1412 during structural fires that offer reduced physiological stress (heat stress)
- 1413 • Identify and evaluate at least one light-weight personal cooling technology for fire
- 1414 fighter use during structural fires and validate performance with human subject
- 1415 testing.
- 1416 • Identify and evaluate new technologies for body work physiological sensors to
- 1417 monitor impact of PPE on human performance.
- 1418 • Identify and evaluate new protective garment materials technologies and design
- 1419 configurations that have enhancements in fit, form, and function (e.g., ergonomics
- 1420 and anthropometrics) to improve responder mission performance.

1421 PPT Program managers and senior staff are formal members of various sector committees
 1422 established to ensure their collective expertise is used to define the particulars of each approach
 1423 to addressing these issues. Furthermore, PPT Program researchers work closely with their
 1424 counterparts across NIOSH to ensure similar concerns are addressed at the project level.

1425 A continuing and specific emphasis that such coordination is required across the NIOSH
 1426 organizational structure in order for the Institute to be effective and to use its resources
 1427 efficiently will be required.

1428 ***Coordination of PPT Program Research Efforts with OEP Grant Participants***

1429 Similar coordination needs to be improved between the intramural and extramural research
 1430 efforts across NIOSH. As shown in Figure 2.2, the PPT related grant program effort is
 1431 approximately 2/3rds of the intramural research budget of the PPT Program. Grant activities will
 1432 be incorporated in overall PPT Program research strategy. Better coordination over all phases of
 1433 program planning, implementation, and evaluation will help ensure that available resources will
 1434 be used as effectively as possible.

1435 **2.8 Review of the PPT Program**

1436
 1437 *As stated in the Framework document "[t]he goal of this [review] is to assist NIOSH in*
 1438 *increasing the impact of its research efforts that are aimed at reducing workplace illnesses and*
 1439 *injuries and improving occupational safety and health."*[35] *The PPT Program has structured*
 1440 *this report to enable the Evaluation Committee to focus its review on the Overview of the PPT*

1441 *Program presented in Chapter 2, Goals 1 and 2 presented in Chapters 3 and 4, a single Goal 3*
1442 *effort presented in Chapter 5. Other Goal 3 projects and related activities have been (or are*
1443 *presently being) reviewed as part of their parent programs. The other Goal 3 projects are*
1444 *contained in Appendix D; they are included for completeness and to indicate the comprehensive*
1445 *nature of the PPT Program, but should not be subjected to review here.*

1446

1447 *Though some historical data are presented throughout, this Evidence Package primarily covers*
1448 *the timeframe from 2001 to the present. This directs the Committee's attention to PPT Program*
1449 *activities since the creation of NPPTL in 2001 and is deemed "the most recent appropriate*
1450 *period"[35] for review.*

1451

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